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THE ISTHMUS OF THE EUSTACHIAN TUBE. A CONTRIBUTION TO THE PATHOLOGY AND TREATMENT OF MIDDLE-EAR DISEASES.

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The Eustachian Tube has hitherto been described as consisting of two portions, the cartilaginous or pharyngeal portion, and the bony or tympanic portion. The narrowest part of the tube lies at the junction of these two portions, and is called the isthmus. Although these two portions have been considered as parts of the same anatomical structure, they have very few, if any, characteristics in common. On the other hand, the differences between them, from either an anatomical, histological or pathological standpoint, are very many, and by beginning the description of the two portions at their meeting point, the isthmus, these differences may be more clearly emphasized.

The Cartilaginous Portion, which is directed downwards, inwards and forwards from the isthmus, is situated entirely outside the bony skull; in fact, it lies entirely within the cavity of the nasopharynx. It does not come into relation with any part of the auditory apparatus at any point except at the isthmus. The walls of this portion consist of elastic cartilage, which is present over only a part of its circumference, the remainder consisting of fibrous tissue; the lumen is therefore not constant, but varies with the contraction of the muscles, which are inserted into it. Under normal conditions the lumen is closed; it increases in size from the isthmus

to the naso-pharynx in a trumpet-shaped manner, so that the line of transition between the interior of the tube and the naso-pharynx is not distinctly marked.

The mucous membrane is thick and thrown into folds, especially near the pharyngeal orifice; it is a separate structure from the perichondrium of the surrounding cartilage, and is freely movable upon it; it contains numerous mucous glands and some lymphoid follicles, which increase in number toward the pharyngeal orifice, where the lymph follicles may be heaped up into more or less distinct adenoid masses. From the isthmus to the pharyngeal orifice, therefore, the characteristics of the tubal mucous membrane become more and more similar to the characteristics of the naso-pharyngeal mucous membrane, with which it is continuous.

It is a well recognized fact that practically all acute as well as chronic inflammatory conditions of the tubal mucous membrane are due to extension from the naso-pharyngeal mucous membrane, and convalescence cannot be established in the tube until the mucous membrane of the naso-pharynx has been restored to a condition approaching the normal.

From every point of view, therefore, the pharyngeal portion of the tube is homologous with the naso-pharynx, of which it must be considered a part.

The Tympanic Portion of the tube is directed backwards, upwards and outwards from the isthmus, and lies wholly within the bony structure of the skull. Its lumen is therefore constant and is normally open. It increases in size from the isthmus toward the tympanic cavity, into which it merges in an imperceptible manner, so that there is no distinct line at which the tube ends and the tympanic cavity begins. It lies in immediate relation with the most important part of the auditory apparatus, the cochlea, whose bony capsule forms its posterior wall. Its superior wall is formed by the bony canal for the Tensor Tympani muscle, another important auditory structure. Its floor, which is at the same time the roof of the carotid canal, is frequently irregular, and contains depressions or small pockets. In temporal bones having a markedly pneumatic structure, it is frequently found that the mastoid cells extend along the floor of the tympanic cavity; such cells may extend so far forward that they underlie the floor of the tympanic portion, and are known as tubal cells.

The mucous membrane is thin and smooth; contains few mucous glands and no adenoid tissue; its deeper layer constitutes the

periosteum of the surrounding bony walls; in all these respects it is similar to the mucous membrane of the tympanic cavity.

In all acute and chronic inflammatory conditions of the tympanic cavity the bony portion of the tube is also involved, and measures directed to the cure of middle-ear diseases have often been without avail because the tympanic portion of the tube has not received appropriate treatment.

From every point of view, therefore, the tympanic portion of the tube is homologous with the tympanic cavity, and it should be regarded as a part of the same.

The views here enumerated entail some slight changes in the usual conception of the anatomy of the middle-ear. Instead of regarding the middle-ear as a sort of drum-shaped box, having a superior, inferior, external, internal, anterior and posterior wall, it should be regarded as an almond-shaped cavity, extending from the aditus ad antrum above, behind, and externally, in a downward, forward and inward direction, as far as the isthmus. In other words, at the isthmus the middle-ear ends and the naso-pharynx begins. Everything internal to the isthmus is naso-pharynx, everything external to it, middle-ear. The isthmus is the natural orifice of the middle-ear, and is analogous to the natural orifices of the accessory cavities of the nose.

While nomenclature is perhaps a matter of secondary importance, it would add to the clearness with which this conception is understood, if the names were made to express the true relations of the parts. The term "tympanic orifice" of the tube, which is only an arbitrary location, should be abandoned altogether; and just as the upper portion of the tympanic cavity is known as the epitympanum, and the lower part as the hypotympanum, so the part hitherto known as the bony portion of the tube could appropriately be called the *pretympanum*.

Starting with this hypothesis, this conception gives to the isthmus the point at which the middle-ear empties into the naso-pharynx, a degree of interest and importance which it has not hitherto possessed. In the following pages, therefore, the writer will discuss the influence of this region in certain important diseases of the ear; the instruments which he has devised for the purpose of approaching it for diagnosis as well as for the treatment of these diseases; the technic of operative procedures upon the isthmus; and the results of clinical experience, which, though limited in amount, are so striking in character, that there is every reason to

believe that they will be confirmed by the larger experience of the profession.

The isthmus of the tube may be reached for diagnostic or operative purposes by two different routes:

First, from the pharyngeal side through the Eustachian catheter, and,

Second, through the external auditory canal, through an incision made for this purpose in the anterior part of the drum membrane, or through a perforation previously existing as the result of disease.

PART I.—THE ROUTE THROUGH THE EUSTACHIAN CATHETER.—THE INSTRUMENTS.

The Catheter. (Figure 1). As the mouth of the Eustachian tube is a conical opening, a slender catheter will go further into the tube than a thicker one; hence the distance from the end of the catheter to the isthmus will vary with the thickness of the catheter, so that it is necessary to adopt a catheter of standard thickness. Its lumen



Figure 1.

must be large enough to accommodate the largest instrument which may be passed through it. Its end must be well rounded, to avoid injury to the tube. The distance to which any instrument is advanced beyond the end of the catheter must always be measured; this is accomplished by means of a scale which is read at the proximal end of the catheter; hence the catheter must be of standard length. The one which I use has an internal diameter of 2 mm.; the external diameter at the bulbous end, 3.5 mm.; the length, 14 cm. The proximal end has a conical expansion to fit various connections. It is made of virgin silver.

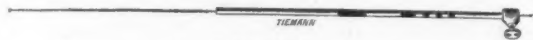
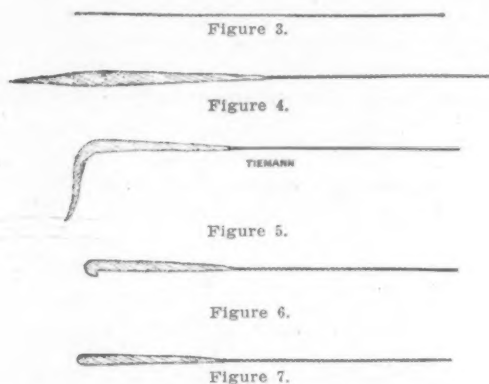


Figure 2.

The Eustachian Applicator. (Figure 2). This instrument consists of a metal tube about 1.5 mm. in thickness and 10 cm. long, provided with a set-screw at one end. It is marked with the scale above referred to. Through this tube a wire is passed and secured by means of the set-screw in such a position, that when passed through the catheter up to the beginning of the scale, the end of

the wire corresponds to the end of the catheter. The wire is made of a double strand of very thin steel wire twisted together. At the distal end, the two strands form a tiny loop, so that the end is smooth and rounded. This construction was devised, first, because it gives us a perfectly straight wire, which is much more flexible than a single wire of the same thickness, and second, because the loop at the end (Figure 3) is of slightly larger diameter than the body of the wire, and this, together with the screw-like form, enables us to load the end with a tuft of cotton in a firm and safe manner. The cotton is first wound around the end of the wire in a manner similar to a nasal applicator. The end is not left soft and fluffy,



Figures 3, 4, 5, 6 and 7 are magnified about two diameters.

however, but is twisted firmly beyond the end of the wire (Figure 4). The projecting part is then bent at right angles (Figure 5), cut off with scissors close to the wire (Figure 6) and then smoothly rounded off between the fingers (Figure 7). It is saturated with the desired solution and then passed the required distance into the tube. There is no danger of losing the cotton. In fact, it cannot be removed from the wire unless it is scraped off with a knife. During the last two years I have made nearly one thousand applications with this applicator, up to and beyond the isthmus, without once losing the cotton, or even having it become loose on the wire.

The Eustachian Bougie. (Figure 8). Bougies are made of celluloid whalebone or gum-elastic material. The larger sizes of celluloid and whalebone bougies are too rigid, and the smaller sizes do not accomplish the desired purpose. Gum-elastic bougies are

more satisfactory in this respect. All bougies are olive-pointed, a fact of which advantage is taken for diagnostic purposes. They should be provided with a scale like the applicators.

Eustachian Sounds. (Figure 9). These instruments bear the same relation to the bougies that urethral sounds bear to the Bougie à Boule. They are of uniform diameter throughout, but are slightly conical and rounded at the point. They are made of a woven tube, covered with an elastic material, and then coated with a soft smooth varnish, which permits their being boiled. They are very soft and silky to the touch, but may be made more rigid by filling their lumen with silkworm-gut. Their texture enables them to be passed without pain, and almost without sensation, on the part of the patient. Owing to their flexibility, it is impossible to exert enough force in introducing them to injure the lining of the tube.



Figure 8.



Figure 9.



Figure 10.

Their color is a bright brick-red, which is a decided advantage, as it makes them easily visible through the drum-membrane. They are provided with a scale like the other instruments.

The Scale. (Figure 10). Whatever instrument is passed through the Eustachian tube, it is a matter of the first importance to know beyond any doubt that the instrument lies within the lumen of the tube, and that it has not made a false passage or been bent back upon itself at the isthmus. The sense of touch is not a positive guide even in experienced hands, and the so-called "tympanic expression" is not elicited when the tube has been cocainized. The only positive way to ascertain that the instrument has been properly passed, is to advance it so far that its end becomes visible behind the anterior margin of the drum-membrane. As the distance between the anterior margin of the drum and the handle of the malleus is about 4 mm., the instrument must be advanced beyond the isthmus with great caution, 1 or 2 mm. at a time, the drum being inspected after each advance. Moreover, while the distance from the end of the

catheter to the isthmus is about 25 mm., and does not vary much in adults, the distance to which an instrument may project from the catheter until its end becomes visible behind the anterior margin of the drum, varies from 27 to 37 mm. It is therefore necessary to provide all such instruments with a scale which shall indicate single millimeters, at least for all distances beyond the isthmus point. As these instruments are too small to permit of printing a numerical scale upon them, the following device has been adopted with entire satisfaction. Bands, of a color contrasting with the color of the instrument, are painted around its shank. When the instrument is passed into the catheter up to the beginning of the first band, the end of the instrument is flush with the end of the catheter. This first band is 10 mm. long. It is followed by a space of 10 mm., beyond which a second band, 5 mm. long, is situated. The end of this band marks 25 mm., the usual situation of the isthmus. Beyond the isthmus point there are three narrow bands, 2 mm. wide, separated by spaces of 2 mm. The junction of bands and spaces therefore marks the odd millimeters, up to 37 mm., the center of a space or band, the even millimeters. The use of such a scale enables us to pass the bougie or sound into the middle-ear with perfect safety, as the exact distance to which it has been introduced is always known and can be easily controlled. When once the measurement for a given patient is known, the instrument can be reintroduced, to the previously ascertained point, with perfect assurance that it will lie in exactly the same position. When applications are to be made to the isthmus or to the region just beyond the isthmus, the position of the applicator can be known exactly by this means, and only by this means. Experience has convinced me that the passage of any instrument into the tube without a carefully-graduated scale to indicate its position, is not only crude guess-work, but is actually dangerous to the drum-membrane and to the chain of ossicles, and should never be attempted by the careful surgeon.

THE USE OF THESE INSTRUMENTS FOR DIAGNOSTIC PURPOSES.

The Eustachian Applicator: In chronic catarrhal conditions of the middle-ear, the mucous membrane of the middle-ear and tube is swollen and thickened. A slight amount of thickening in the cartilaginous portion of the tube will not interfere seriously with the ventilation of the middle-ear, as the cartilage is yielding and the tube is actively opened by muscular contraction; but in the narrow part of the unyielding bony canal, just to the outer side of the

isthmus, the slightest amount of swelling will cause obstruction. The only method which has been known up to the present time, of applying cocaine or adrenalin or both, to the tubal mucous membrane, consists of injecting the solution into the catheter and blowing it into the tube. Even when the tube is patent, it is difficult to inject such solutions beyond the isthmus unless undue force is employed. When there is obstruction in the tube, it is almost impossible to accomplish this result at all; at any rate it is quite impossible to know definitely that the solutions have reached the desired point, the region just beyond the isthmus. With the use of the Eustachian applicator, however, this procedure becomes at once simple, easy and certain.

The applicator, having been charged with a solution containing 5 per cent cocaine and 1 to 2,000 adrenalin, is passed into the tube for a distance not exceeding 25 mm., and allowed to rest there for a moment until the solution has had time to take effect. The applicator is then advanced one or two millimeters into the obstruction and again allowed to rest. Advancing slowly in this manner, the obstruction will be found to yield gradually before the applicator, and the tube becomes patent. If the ear has been inflated before the application, and the inflation is repeated afterward with the same air-pressure, a considerable difference in the sound heard in the auscultation tube will be perceived.

This procedure not only informs us that the mucous membrane of the pretympnum is swollen, but it enables us to determine the nature of the swelling. If the swelling is due to congestion, dilatation of the blood-vessels, or edema, it will disappear after cocaineization; but if the swelling be due to an exudation of leucocytes, fibrous tissue or cicatricial contraction, no reduction of the swelling takes place. In other words, the application of cocaine to the bony portion of the tube beyond the isthmus is necessary in order to distinguish between simple swelling and organic stricture.

The fact that cocaine and adrenalin, applied by means of the applicator to the region beyond the isthmus renders inflation more effective, is also of importance in prognosis. If inflation is attempted when the tube is swollen, the air will either not enter the middle-ear at all, or will enter it in insufficient amount, and no improvement in hearing follows. If great force is used, the air will enter the ear, but in such excessive amount that it will be under positive pressure and the drum will bulge outwards; for the obstructed tube will prevent the excess of air from escaping as

well as it will prevent the air from entering. In this case also no improvement in hearing follows. In such cases it is customary to decide that treatment will be unavailing. The true effectiveness of inflation cannot be determined unless the tube is known to be patent at the time, so that after inflation a true balance of air-pressure on both sides of the drum-membrane is assured. One of the most valuable uses of the Eustachian applicator in my hands has been to enable me to avoid this very common error.

The applicator serves a useful purpose in determining the shape of the isthmus. If an applicator which has been allowed to lie in the isthmus for a few minutes be examined, it will be found that the cotton tuft has assumed the shape of the passage. Generally the cross-section of the isthmus is round or irregularly triangular; occasionally, however, the cotton tuft will be found to be flat or crescentic in shape, showing that the isthmus has a slit-like form. The recognition of an isthmus of such shape is very important, as a slit-like isthmus will not permit a large-sized bougie to pass, even after it has been thoroughly cocaineized and adrenalized. Unless it is known that one is dealing with a slit-like isthmus, a mistaken diagnosis of stricture is unavoidable, and an erroneous prognosis and much useless treatment is the result. The possibility of the presence of a slit-like isthmus and its importance in the diagnosis of stricture, has not hitherto been published. A recognition of the shape of the isthmus is also of value in selecting the instruments necessary for operative procedures upon the isthmus, to be described later.

Bougies. The ordinary Eustachian bougie, which is provided with a scale, may be used to determine the location of the isthmus, which can always be recognized by the increased resistance at this point, even when the tube has been cocaineized. The increased resistance caused by the normal isthmus begins rather suddenly at a distance from the end of the catheter of from 20 to 25 mm., and ends when the bulb of the bougie has passed this point. When the bulb of the bougie is short, this resistance will end more abruptly.

When the increased resistance extends over a greater length than can be accounted for by the length of the bulb, the presence of swelling of the mucous membrane of the tube beyond the isthmus may be assumed. This diagnosis must be verified, however, by the disappearance of the increased length of the resisting area after this part of the tube has been cocaineized. Thus, if a given bougie,

which has been found to pass a normal isthmus with an increased resistance for 3 mm. of its course, is passed into a diseased isthmus, and is found to meet with increased resistance at 23 mm., and to leave the area of increased resistance at 29 mm.; but after cocaine enters at 23 mm. and leaves at 26 mm., it may be considered as proven that the tube is swollen for a distance of 3 mm. beyond the isthmus. When such a measurement has been determined, it is used as a guide for the introduction of remedial agents by means of the applicator.

When the tube has been cocaineized and adrenalized, and, by observation of the applicator, the presence of a slit-like isthmus has been excluded, the diagnosis of stricture is made when a bougie of normal size, 1.5 mm., fails to pass. Rigid bougies, such as those made of celluloid or whalebone, especially the larger sizes, are apt to lead to error. For, when a bougie passes through the tube, it must assume the curvature of the tube; this curvature has the shape of the letter S; hence the bougie must be bent twice in its passage. Now, having assumed a given curvature, even a rigid bougie may be advanced a limited distance without change of curvature; when advanced further, however, it must change its form; this means increased force, which is interpreted as increased resistance, and so an erroneous diagnosis of multiple stricture, a most rare condition, might be possible. The more flexible bougies will accommodate themselves to the curvature of the tube without evident change of resistance, and by using such bougies this error may be avoided.

THE USE OF THESE INSTRUMENTS FOR THERAPEUTIC PURPOSES.

The Eustachian Applicator is employed for the purpose of applying medicinal agents to the entire interior of the tube. Cocaine, when used to reduce swelling, need not be stronger than 5 per cent; stronger solutions are apt to produce a reaction after 6 to 8 hours, when the anesthetic effect has passed off. The same is true of adrenalin when used stronger than 1 to 2,000.

Various drugs have been tried for therapeutic purposes. Solutions of alum, aluminum acetate, tannic acid, iodine, and nitrate of silver, when applied to the tube, cause a characteristic pain, which usually lasts for about twelve hours. It is a continuous, dull, neuralgic ache, felt in the side of the neck along the anterior border of the sterno-mastoid muscle, from the ear to the larynx. When cocaine has been used previous to the application, the pain comes on about an hour after the treatment.

The writer has found argyrol to be a most valuable drug. Not only is its use entirely free from pain, in as high concentration as 50 per cent, even without the previous use of cocaine, but its antiseptic and astringent qualities are apparently as efficient in the Eustachian tube as they have been found to be in the eye.

Inflammation of the middle-ear has never followed as the result of the somewhat heroic treatment occasionally applied to the isthmus of the tube.

In acute inflammations of the middle-ear, which usually arise by extension from the naso-pharynx, the mucous membrane of the interior of the tube as well as that surrounding the pharyngeal orifice is swollen and edematous, and it is impossible to pass any instrument into the tube. If, however, the inferior meatus of the nose is thoroughly cocainized, and through this, cocaine and adrenalin are applied to the mouth of the tube with a nasal applicator, the catheter may be passed without pain. If an Eustachian applicator, charged with cocaine and adrenalin is now passed through the catheter, it will meet with resistance from the swollen mucous membrane of the interior of the tube; but if it be allowed to rest in this position, the swelling will recede and a slight advance can be made. If the advance be made slowly, giving the drugs time to act, the entire tube can be made patent without occasioning any pain to the patient. An application of 25 per cent argyrol solution may now be made with another applicator, as far as the isthmus.

Following this procedure, there is an immediate cessation of the throbbing earache and tinnitus, the predominant symptoms. If the inflammation be of a mild degree of virulence, or if the case be seen in its earliest stages, before redness and bulging of the drum-membrane are present, the relief obtained will be permanent and the disease will be brought to an immediate and abrupt termination, often by one single application. When, however, redness and bulging of the drum-membrane indicate the probable presence of pus in the middle-ear, the relief of the symptoms, though equally pronounced at the time, and though accompanied by a diminution in the degree of redness of the drum and a partial recession of the bulging, will not be permanent; in the few cases in which the writer has tried it, the symptoms returned after 6 to 8 hours, so that paracentesis had to be done on the following day.

The writer is of the opinion that it would be perfectly possible to abort an acute inflammation of the middle-ear in adults, even

after suppuration has become established, by repeating such applications at intervals of six hours; but this would require close observation and control of the patient in a hospital bed.

The writer has attempted to shorten the period of suppuration in acute otitis media by maintaining the patency of the tube, but has not succeeded in materially influencing the duration of the discharge in any of the cases.

On the other hand, in the terminal stages of the disease when the discharge has ceased and the perforation has closed, but when deafness, tinnitus, fullness in the ears, etc., persist, the use of intratubal applications of argyrol has yielded prompt and definite results. Cases which have done badly under the usual methods of treatment, have undergone immediate and rapid improvement as soon as the use of these applications was added to the treatment, while cases in which such applications have been begun as soon as perforation had closed, have been relieved of the terminal symptoms in a relatively short time.

In subacute inflammation of the middle-ear the application of argyrol solutions to the interior of the tube is employed from the beginning of the treatment. Such applications have been found to be especially efficacious in that form of subacute otitis characterized by the presence of serous or sero-mucous fluid in the tympanic cavity, cases which have hitherto been found to be particularly obstinate to the usual methods of treatment. By restoring the patency of the tube by means of intratubal applications of cocaine and adrenalin, and maintaining this patency by the use of 50 per cent solution of argyrol applied well beyond the isthmus, the fluid, and with it the subjective symptoms, have been found to disappear in as many days as it would otherwise have taken weeks.

In the treatment of that class of diseases known variously as chronic catarrhal otitis, chronic dry otitis, or adhesive middle-ear catarrh, the object has been, first, to reduce the swelling of the mucous membrane of the middle-ear directly by proper inflation; and, secondly, to restore the physiological ventilation of the middle-ear, i. e., the normal exchange of air between the ear and the naso-pharynx.

By proper inflation of the middle-ear, it is meant that the air is driven into the ear gradually, beginning at the lowest possible pressure, gradually increasing to the desired maximum pressure, and maintaining this maximum pressure for a definite time. This

procedure must be followed by complete *deflation* of the ear; that is to say, the pressure is gradually lowered as far as possible, and the excess of air still remaining in the ear is allowed to pass off through the tube. (This procedure requires the use of compressed air, a regulator and gauge, and a cut-off which permits of turning the air on gradually. The so-called instantaneous cut-off should never be used for inflation.)

In order to carry out inflation in this manner, it is absolutely necessary that the tube should be entirely patent at the time. In the cases under consideration, however, there is always some degree of tubal obstruction; for when the mucous membrane of the middle ear is swollen, that of the pretympanum (the tympanic portion of the tube) partakes of the swelling. In the narrow part of the passage, just beyond the isthmus, the slightest amount of swelling will cause obstruction and interfere with inflation. Hence it becomes necessary to precede the inflation by temporarily restoring the patency of the tube by the application of cocaine and adrenalin solution to the region just beyond the isthmus, by means of the Eustachian applicator.

If the diagnosis of organic swelling has been made, in which case the use of cocaine and adrenalin will not restore the patency of the tube, the application of these drugs is followed by the passage of the Eustachian sound. The use of the sound in preference to the bougie is to be emphasized. The purpose of the instrument is to cause dilatation. Now, the bougie has a bulbous end, and if the stricture will permit the head of the bougie to pass, the narrow neck behind it can cause no dilatation. On the other hand, sounds, such as described above, have a uniform diameter close to the tip, and when the largest possible size has been passed, and has been allowed to remain in the tube for 5 or 10 minutes, the necessary dilatation will be accomplished.

In order to restore the normal ventilation of the middle-ear, the patency of the tube must be made permanent. Such a result may at times be accomplished by the methods thus far described, if they are repeated at regular and sufficiently frequent intervals. Much more rapid and satisfactory results are obtained, however, if after each treatment as described, an application of 50 per cent solution of argyrol is made to the region beyond the isthmus, by means of the Eustachian applicator.

The writer has thus devised a routine plan of treating the isthmus of the tube, which may be summed up as follows: 1. The application of cocaine and adrenalin solution to the region just

beyond the isthmus. 2. The passage of the largest possible sound for 5 or 10 minutes. 3. The application of 50 per cent solution of argyrol to the region beyond the isthmus. 4. Inflation and deflation as above described, with or without the addition of medicated vapor to the air.

In the case of old and firm strictures, the use of sounds must be more frequent and prolonged. If the form of sound above described is used, it may be passed daily without causing any unpleasant reaction. The sound must be left in situ for at least 15 minutes. When this has been done a few times, it will be found that when it is removed a larger-sized instrument may be passed. Eventually, the larger size will pass without the previous use of the smaller, and in this way the size of the sound can be gradually increased. When the largest sound passes easily, the interval between the treatments is prolonged, but it will probably be necessary to pass the sound occasionally about once in two or three months, for the rest of the patient's life.

I have devised an instrument by means of which these strictures can be cut, which will be described in the second part of the paper.

I have refrained from reciting detailed case histories, first, in the interest of brevity, and secondly, because their value would be limited by the fact that applications to the tube have not been the only factor in the treatment of any of the cases. Most of this work was done in private practice, and in each case every known method of influencing the middle-ear condition was employed. The fact, however, that many of these cases have previously been in the hands of able otologists, who have not failed to employ every hitherto known method of treatment, both direct and indirect, but without result; that practically the only addition which I have made to the treatment has been in the use of the Eustachian applicator; and that such patients have enjoyed a prompt and decided improvement in their hearing power; these facts justify, to my mind, the conclusion that the Eustachian tube is much more tolerant to manipulation and local treatment than is generally supposed, and that the Eustachian applicator is an indispensable addition to the armamentarium of the otologist.

PART II.—THE ROUTE THROUGH THE EXTERNAL AUDITORY CANAL.— THE INSTRUMENTS.

In order to ascertain the possibility of instrumental treatment of the isthmus of the tube from the external auditory canal, either through an incision made for the purpose, or through a perforation

already existing as the result of disease, as well as to determine the character of such an instrument, it was first necessary to know the exact relation of the parts from this point of view. A section of a fresh anatomical specimen was therefore made by passing a vertical saw-cut through the center of the external auditory canal, the middle-ear, and the tube. Such a cut was found to be, not a flat surface, but a section of a cylinder, the concavity of which is directed outwards and forwards. (Figure 14.) This section, viewed from the front, showed that the external auditory canal, the middle-ear, and the tube, form a continuous curved line, the concavity of which is directed outwards and downwards, the mid-



Figure 14.

dle-ear occupying the highest point of the curve. (Figure 13). A simple instrument, such as a probe, bent to conform to the curve, can be easily passed into the tube of the cadaver as far as the isthmus; in the living subject it is impossible to pass such an instrument, because, in order to obtain a view of the middle-ear it is necessary to straighten out the canal by drawing the auricle upwards and backwards. By reversing the procedure, however, namely, by fixing the auricle in the cadaver in the position which it occupies during examination, shaping the probe to lie in the passage so fixed, and then studying the best way to withdraw it, an instrument was devised which could readily be passed as far as and through the isthmus in the living subject. Such an instrument consists of a shank about 7 cm. long, of which 2 cm. at the end are curved to a form which nearly corresponds to an arc of a circle 5 cm. in diameter; it is attached to a suitable handle. The

writer has placed in the hands of the instrument-maker a templet of this curve, so that its exact form can always be reproduced.

The technic of introducing the instrument is as follows: A short aural speculum is introduced into the external auditory meatus without making traction upon the auricle, and the instrument is introduced into the canal as far as the eye can see. Traction is now made upon the auricle in an upward and backward direction, the instrument being advanced at the same time under the guidance of the eye. When the tympanic cavity is reached, the instrument is

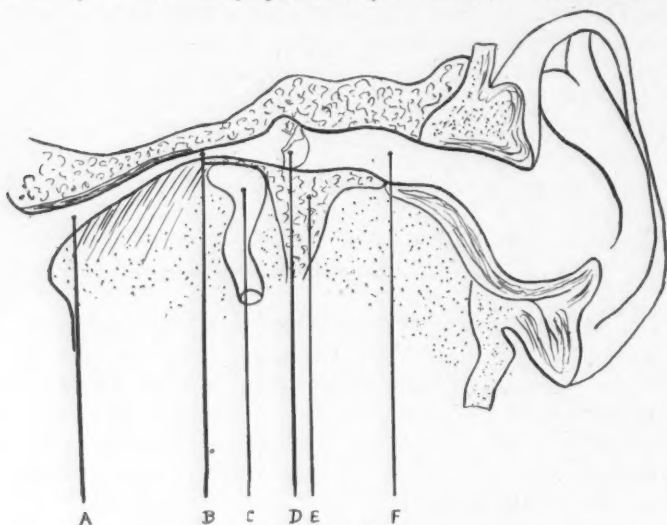


Figure 13.

A. Pharyngeal Orifice. B. Isthmus. C. Carotid Artery. D. Drum Membrane.
E. Styloid Process. F. External Auditory Canal.

rotated, so as to bring its end into the anterior part of the cavity, and as soon as the opening of the tube is brought into view the end of the instrument is introduced into it. Traction upon the auricle is continued, and the instrument finds its way into the tube without difficulty, until the entire curved portion of the instrument has passed out of view beyond the anterior margin of the drum-membrane. In this position the end of the instrument is a few millimeters beyond the isthmus. It is not fixed, but slight lateral and rotary movements may be carried out. All operative procedures must, of course, be guided by the sense of touch alone. The withdrawal of the instrument is accomplished by reversing the movement of introduction.

Applicators: Ordinary nasal applicators may be bent to conform to the required curve, and are used to make applications of cocaine, adrenalin, etc., to the isthmus.

The Salpingeal Probe. (Figure 11). This is an ordinary probe fixed in a handle, and bent to the required curve. It is used to determine the exact direction of the bony passage. The presence of a soft place, indicating the existence of a dehiscence of the bony wall of the tube, can be detected with the probe. It also indicates the presence of denuded or carious bone, which is occasionally found on the floor of the tube.

The Salpingotome. (Figure 12). This instrument consists of a shank about 1 mm. in diameter, and of the same length and curvature as the other salpingeal instruments. For a distance of about 5 mm. from the end, it is sharpened to a keen knife edge. The extreme end is blunt and probe pointed. The position of the



Figure 11.



Figure 12.



Figure 15.

knife edge is such that when introduced into the isthmus, the edge is directed upwards and forwards. The instrument is intended to cut obstinate strictures of the tube at the isthmus, and in this direction there would be least danger of injuring important structures.

The Salpingeal Curette. (Figure 15). This instrument consists of a shank which is curved like the other instruments, and surmounted by a hemispherical head, the flat side of the hemisphere being directed toward the handle. It will be described in detail below.

DISEASES WHICH MAY BE INFLUENCED BY TREATMENT OF THE ISTHMUS THROUGH THE EXTERNAL AUDITORY CANAL.

Strictures of the Eustachian tube at the isthmus. The operation of salpingotomy consists of cutting a stricture of the tube at the isthmus by means of the salpingotome. An incision about 3 mm.

long is made in the anterior part of the drum membrane about 1 mm. from its anterior border, its lower end being at the level of the umbo. Through this incision an application of cocaine and adrenalin is made with the applicator, the pharyngeal portion of the tube having been previously cocainized by means of the Eustachian applicator. The salpingotome is then introduced and advanced through the isthmus. By pressing the handle backward and downward, the knife-edge is forced into the mucous membrane. The instrument is now withdrawn, and in so doing the mucous membrane is incised down to the bone. After proving, upon the cadaver, that this operation was actually feasible, the writer performed it in one case, the history of which follows:

The patient, a woman 36 years old, who came under my care a number of years ago, stated that she had noticed a gradual loss of hearing for some years. Upon examination it was found that the hearing was diminished in both ears to a very marked degree, so that ordinary conversation could only be heard at a distance of about 4 inches. The hearing was diminished for all tuning-forks, more for air-conduction than for bone-conduction, as the low forks could be heard equally by bone and air. The loudness of the forks was not influenced by compressing the air in the external meatus.

The hearing was somewhat better on the left side than on the right, and examination of both tubes showed that on the right side there was a stricture of the tube at the isthmus, which was so extreme that only a very fine bougie could be passed even after the isthmus was cocainized. The left tube was patent. Under treatment it was possible to dilate the stricture so that a moderate-sized sound could be passed, but the dilatation could not be maintained for any length of time without passing the sound frequently. When the tube was dilated, speech could be heard at 24 inches.

About a year ago treatment was discontinued altogether, and when the patient returned in the early part of this year her hearing was again as bad as when I first saw her.

On February 14, 1910, it was possible to pass only a very small sound, and it was decided to cut the stricture. The isthmus was thoroughly cocainized with the Eustachian applicator. An incision 3 mm. long was then made near the anterior border of the drum-membrane at about the level of the end of the hammer-handle, and through this an application of cocaine and adrenalin was made to the tympanic side of the isthmus. The salpingotome was intro-

duced through this incision into the tube, and the stricture cut. Immediately afterwards it was possible to pass a sound 1.4 mm. in diameter, which was allowed to remain for 5 minutes. The external auditory canal was then filled with cotton. For 10 hours after the operation there was considerable pain along the side of the neck, referable to the tube.

On the following day there was no local reaction in the middle-ear, but the edges of the incision had not united. On the third day the incision was still open, its edges were dry, the drum-membrane in its immediate neighborhood was not reddened, but was clear and transparent. An attempt was made to pass the Eustachian applicator into the tube, but it was not possible to enter it more than 18 mm. An application of 50 per cent argyrol was made. On the seventh day the incision was still open and its edges clean, dry and transparent. An application of cocaine and adrenalin was now made to the isthmus; a sound 1 mm. in diameter passed, and an application of argyrol was made. The procedure was painless and no pain followed afterwards. On the tenth day the opening in the drum-membrane no longer had a linear form, but was small and round, its edges were moist and granulating, the surrounding drum-membrane was opaque and covered with mucus. A sound 1.4 mm. in diameter was passed and an application of argyrol made. On the fourteenth day the perforation was reduced to a pin-point opening, and the drum-membrane had a cloudy appearance. Sounds were passed and argyrol applied on the eighteenth day and on the twenty-second day. On the twenty-sixth day the perforation was permanently closed, and it was possible to introduce a sound 1.4 mm. in diameter. At the present writing it is six weeks since the operation. It is now possible to pass the sound after cocainization of the tube. The drum-membrane has lost some of its cloudy appearance, and is becoming clearer. The hearing for speech is 24 inches.

From this case we may conclude that the operation of cutting the stricture was followed by swelling of the tubal mucous membrane lasting about two weeks, sufficiently pronounced to cause complete obstruction. During this time there was not the slightest tendency to the formation of granulation tissue on the edges of the drum-membrane. As soon as the tube became patent, the perforation began to granulate, and finally closed after two weeks more. After six weeks all that remained was some cloudiness of the drum-membrane. In six weeks, therefore, the patency of the

tube was restored and the hearing was increased to as great a degree as could previously be accomplished only after many months of patient treatment.

Chronic suppurative otitis media presents such a variety of aspects that no single method of classifying the various cases has as yet received general acceptance. A classification based upon clinical experience may therefore be of practical value. From a clinical standpoint we can distinguish two different forms of the disease. In one class of cases the only symptom which is evident to the patient is the constant discharge from the ear. This discharge may vary in character and in quantity from time to time, but not infrequently the patient gives a history of many years' standing.

In contra-distinction to this class of purely chronic cases, other patients give histories of repeated attacks of acute inflammation in the middle-ear or mastoid cavity. Whether these acute exacerbations are mild or severe, the distinction between these cases and the purely chronic ones is important, because it is becoming more and more clearly recognized that the large majority of labyrinthine and intra-cranial complications of middle-ear disease occur as the result of acute exacerbations of chronic suppuration. Nor is the distinction between these two classes of cases merely a matter of empirical observation, but is in reality dependent upon the vital surgical principle of drainage. For it is in those cases in which drainage is obstructed that there is retention of pus under pressure, resulting in acute inflammatory symptoms and progressive extension of the suppurative cavity. These cases generally come under observation during an acute exacerbation, and should be regarded as cases of acute mastoiditis rather than as cases of chronic suppuration.

On the other hand, if in all cases in which there are no acute symptoms, the drainage is sufficiently good to prevent retention of pus, then we should expect these cases to get well if sufficient time be allowed and they be kept reasonably clean. For the pathology of the suppurative process is in no wise different from bone abscess elsewhere in the body; and a bone abscess in any other part of the body, as large as the mastoid cavity, which is draining well and which is kept clean, in a patient otherwise in good health, will invariably be cured *in time*. On the other hand, even though the sclerotic process in the mastoid bone and the lining of the bone cavity with granulations indicate an effort on the part of nature to heal the abscess cavity, nevertheless a suppurating ear, in spite of

the most painstaking local treatment, will not be cured and remain permanently well, but will frequently last during the whole of the patient's life. We must therefore seek another cause, in addition to the local suppurative process, to account for the *persistence* of aural suppuration.

Now, this additional cause is to be found in the constant re-infection of the middle-ear through the Eustachian tube, and in spite of the academic simplicity of this explanation it may be of interest to study the exact mechanism of this re-infection in detail.

Under normal conditions, when the drum-membrane is intact, it is a matter of some difficulty to blow foreign substances through the Eustachian tube into the middle-ear. It does not usually occur during the ordinary acts of swallowing, blowing the nose or sneezing. On the other hand, when the drum-membrane is perforated, it is very easy to propel particles of mucus, etc., through the tube. The difference may be well illustrated by the experiment of blowing smoke into a narrow-necked bottle. It will be found that it is almost impossible to fill the bottle with smoke; but if a hole is made in the opposite side of the bottle, it is very easy to fill it with smoke. In like manner, the intact drum-membrane prevents the passage of strong air currents through the tube, while the presence of a perforation permits and facilitates it. This protective action of the drum-membrane, although very evident, is not mentioned in literature among the functions of this organ. It is equally as important as the auditory function, if not more so; for the drum-membrane is not indispensable for the purpose of hearing, as it is quite possible to hear when the drum has been destroyed; but an intact drum is indispensable for the protection of the middle-ear, as it has hitherto been practically impossible to prevent suppuration of the middle-ear, when the continuity of the drum has been permanently destroyed. The mere presence of a perforation, therefore greatly facilitates the communication between the middle-ear and the naso-pharynx and all the changing bacterial flora of this infected region are constantly being added to the already existing sepsis in the drum cavity.

Not only are germs transmitted from the naso-pharynx to the ear, but particles of mucus are propelled bodily through the tube, and add their bulk to the secretion actually formed in the ear itself. The quantity of mucus which may thus be directly transmitted is unknown; but the quantity of the aural discharge varies

synchronously with the naso-pharyngeal secretion, and it can be seen with such regularity in the mouth of the tube and on the floor of the middle-ear, that it is probably much larger than is generally suspected. The fact, therefore, that the amount of the aural discharge is too great to have been formed in the middle-ear cannot be considered as indicating, as is generally supposed, that it must have come from diseased mastoid cells, as ulcerated bone secretes pus, whereas the aural secretion consists in large part of mucus, which could only be derived from the naso-pharynx.

The presence of naso-pharyngeal mucus in the middle-ear keeps it in a state of moisture, and in addition, with every act of swallowing, the warm moist air of the naso-pharynx sweeps through the middle-ear cavity and helps to maintain, in the diseased organ, all those conditions which are favorable to the development and propagation of the infectious agencies.

Now, if this hypothesis be correct, then it must follow as a necessary corollary, that if the communicating passage between the middle-ear and the naso-pharynx be obliterated by producing artificial atresia of the Eustachian tube, the suppurative process must become capable of early resolution, at least in a large percentage of the purely chronic cases.

During the last few years it has become clearly recognized by all otologists, that in order to ensure successful healing after the radical operation an attempt must be made before concluding the operation to effect the closure of the Eustachian tube by curetting its tympanic orifice. Before this fact was recognized, the majority of radical operations resulted in failure. Since the closure of the tube has become the regular practice, the majority of radical operations are successful. The difference between failure and success, therefore, consists in closing the tube. The only question is whether the cart has not been placed before the horse. The writer is of the opinion that if the Eustachian tube be closed in the proper manner, the rest of the radical operation will, at least in a majority of the purely chronic cases, be superfluous and unnecessary.

The method which has been employed for closing the tube at the end of the radical operation consists either of curetting the neighborhood of the so-called tympanic orifice, or of utilizing the remnants of the drum-membrane to cover the opening. In as much as the tympanic orifice of the tube is a purely arbitrary location, these methods are equivalent to an attempt to construct a diaphragm across the middle-ear cavity. This procedure is apt to fail

because of insufficient curettage of the small tubal cells of the floor of this region, through which communication may be re-established between the pretympaum and the middle-ear, or because the diaphragm closes the passage above, but in the lower part becomes continuous with a cicatricial bridge, which forms between the lower margin of the drum-membrane and the promontory, leaving a fistulous tract along the floor of the middle-ear communicating with the Eustachian tube. Such a fistulous tract is occasionally present as the result of the disease itself, and may extend as far back as the aditus ad antrum, where it communicates by a small opening with the upper part of the tympanic cavity. For these reasons, the so-called tympanic orifice is an uncertain and unreliable location for producing atresia of the tube.

On the other hand there are many reasons why the isthmus of the tube is the most favorable location for this purpose. Not only is it the natural orifice of the middle-ear, and the termination of the middle-ear cavity, but it is the narrowest part of the entire passage. In addition, the isthmus is a situation at which cartilage is joined to bone, and like other such places, as the epiphyseal lines of growing bones, the chondro-costal articulations and the suture lines of the nasal septum, constitutes a *locus minoris resistentiae*, where irritation quickly results in stimulating granulation and the production of new bone. (It is for this reason that the isthmus is the most frequent site for the occurrence of strictures of the tube.)

The writer has already shown that it is not difficult to reach the isthmus with instruments passed through the external auditory canal, and it would have been a simple matter to construct various instruments for the purpose of producing atresia at this point. For instance, it would not be difficult to construct a caustic carrier, by means of which any kind of chemical caustic might be deposited at the isthmus. In like manner, a galvano-cautery point could be made to cauterize the isthmus by means of heat. The writer has refrained from even constructing such instruments, for the following reasons: All caustics, whether chemical or thermal, produce their effect by causing local gangrene of the tissues. The dead tissue becomes outlined by a line of demarcation and is then separated from the healthy tissue underneath by a process of supuration, even when the parts can be kept in an aseptic condition, which, of course, in the case under consideration could not be done. Now, the depth to which a given caustic will burn can not be controlled, as a caustic of a given strength will burn deeper in one

individual than in another. In the presence of dehiscences of the bony wall of the tube, when such vital structures as the carotid artery might lie directly under the mucous membrane, it would be extremely dangerous to induce a suppurative process of unknown and uncontrollable severity. On the other hand, the mechanical removal of the mucous membrane, carried out under surgically clean conditions and followed by healthy granulation and cicatrization, seemed to be the most scientific as well as the least dangerous method, especially as the instrument which the writer has constructed for this purpose has been carefully designed so as to avoid wounding any of the important structures in the neighborhood.

The instrument, which has been briefly described above as the salpingeal curette, consists of a shank having the same length and curvature as the other salpingeal instruments, attached to a suitable handle. Its end is surmounted by a hemispherical head with the flat side toward the shank. The circular cutting-edge is sharp, having a cutting-angle of about 60° , which is directed backwards, so that it cuts only in this direction. This fact, together with the rounded outline of the distal side of the head, prevents the instrument from wounding the parts during its introduction, so that it can neither make a false passage nor be plunged through a dehiscence in the bony wall and into the carotid artery. The proximal side of the head is flat and placed at right angles to the shaft. If this surface were made conical, i. e., projecting into the head, the edge would cut better; but such a cutting-edge would have what mechanics call a "positive rake," which would give it a tendency to penetrate into the tissues of its own accord. By making this surface flat, the edge has no "rake," and hence can not penetrate into the tissues unless it is forced into them. In other words, the depth of the cut is under the constant control of the operator. The projection of the cutting-edge from the shank has been adjusted to correspond to the thickness of the mucous membrane. In the smallest curette, this projection is one-quarter of a millimeter, to correspond to the thickness of the mucous membrane of a small isthmus and of the angles of a slit-like isthmus; in the largest size, one-half millimeter. As the instrument cuts towards the shank, the shank always rests upon uncut tissue; hence the edge can never lie deeper than the under surface of the mucous membrane. The cutting-angle of the edge, 60° , is sufficiently large to prevent it from penetrating the bone unless undue pressure is made. Constructed in this careful manner, the instrument has thus far proven itself to be, in the hands of the writer, perfectly safe and reliable.

The technic of the operation which the writer has performed for the purpose of producing atresia of the Eustachian tube at the isthmus is as follows: The external canal and middle-ear are first irrigated with a saturated solution of boric acid. The solution is contained in the author's wash-bottle, which is connected with the compressed air apparatus, so that the pressure of the stream can be regulated. At first the straight cannula is used, then the attic and hypotympanum are irrigated with appropriate cannulae. An application of a solution containing 10 per cent of cocaine and 1 to 2000 adrenalin is then made to the inner tympanic wall, and, by means of the salpingeal applicator, to the tympanic side of the isthmus. The Eustachian catheter is then introduced, and through this the pharyngeal side of the isthmus, and the isthmus itself, are cocainized with the same solution. The applicator is allowed to remain in the isthmus for about 3 minutes, and upon its withdrawal, the shape of the isthmus is noted. The irrigating bottle is then connected with the catheter, and under a pressure of about 10 pounds, the boric acid solution is driven through the tube. The greater part of the fluid returns through the nose and mouth, but the irrigation is continued until a sufficient quantity has passed out of the ear to thoroughly remove all mucus and secretion from the tube.

When the parts have thus been anesthetized, cleaned and dried, the largest curette which will pass the isthmus is inserted through the canal and into the tube according to the technic above described. By a circular motion, the cutting-edge is forced through the mucous membrane down to the bone on all sides of the isthmus, so as to sever it completely from the mucous membrane of the pharyngeal portion. By an inward and outward movement of the instrument, the mucous membrane is then separated from the bone all around the tube for a distance of about 3 mm.; the isthmus is then again encircled, so as to separate the mucous membrane for about 5 mm. all around the tube. The curette is then sharply withdrawn, bringing the separated mucous membrane out with it, i. e., the mucous membrane is inverted like the finger of a glove, the cut-end becoming visible in the middle-ear. When the isthmus is fairly large and round, this procedure will usually be successful; when it is angular or slit-like, the mucous membrane cannot be inverted successfully; in such cases the smallest curette is introduced and the angles and corners thoroughly curetted, so as to destroy or completely remove the mucous membrane therefrom. The ear is then powdered with iodoform or similar powder, and the canal plugged with gauze.

On the following day the gauze is removed, and the ear treated according to the usual conservative methods. The writer has operated in this way upon 21 ears in 17 patients, the histories of which are of sufficient interest to be given in detail, as follows:

Case 1. A woman, 42 years old, came under my care 5 years ago, stating that her left ear had been discharging since an attack of measles when she was 3 years old. For some time there had been a distinct odor and white, cheesy masses began to appear in the secretion.

Upon examination a large perforation was found involving the upper half of the drum-membrane; the ossicles had disappeared from the attic, which was filled with cholesteatomatous masses; there was a small granuloma in the anterior part of the attic. The lower half of the drum-membrane was adherent to the promontory, and a small portion of the hammer-handle was attached to it. Radical operation was refused. Under conservative treatment, including the removal of the granuloma and of the remnant of the hammer-handle, the odor disappeared, but the suppuration and the discharge of cholesteatoma continued, the quantity varying from time to time.

On August 28, 1907, the ear was operated upon. The lower part of the drum-membrane was separated from the promontory with an angular knife, and the region of the Eustachian tube exposed. The orifice of the tube was filled with pus. After cleansing the ear as thoroughly as possible, the tube was curetted as above described, dusted with iodoform, and the canal filled with gauze. On the following day the inner tympanic wall was found swollen and slightly reddened, the discharge in the ear consisting of thin sero-purulent fluid, containing small masses of cholesteatoma. The swelling of the inner tympanic wall lasted two weeks; during this time there was very little secretion, and the ear was treated with insufflations of boric acid powder. After this the patient used instillations of alcohol, and was not seen again until October, when there was still some discharge, but the secretion no longer contained cholesteatomatous particles. In January, 1908, four months after closing the tube, the ear was quite dry and clean, the inner tympanic wall having the dry appearance of skin. The adhesion between the drum-membrane and the promontory had not recurred; the edge of the drum had retracted, so that the entire middle-ear activity was freely open.

Two years later, on March 5, 1910, the patient was again examined. She stated that no treatment of any kind had been neces-

sary during the interval, and upon examining the ear it was found entirely well.

Case 2. A young man, 22 years old, who came under my care November 3, 1907, stated that his left ear had been discharging since he was 8 years old, from unknown cause. Since then the discharge has been continuous, profuse, and purulent in character; there were occasional pains in the mastoid region, but these had not been noticed during the past year. Polypi had been removed from his ear on several occasions.

Examination showed the presence of a large aural polypi filling the entire canal and obstructing the view of the middle-ear. After shrinking the polyp with cocaine and adrenalin, part of it was removed, sufficient to give access to the tubal region. The tube was then curetted. After the operation the discharge became muco-purulent, but was so abundant that another portion of the polyp had to be removed to obtain drainage. The patient was using instillations of alcohol, which had been previously prescribed for him, and he was allowed to continue them, but applications of 10 per cent solution of nitrate of silver were made to the polyp twice a week. The discharge from the ear became very slight, and the polyp became gradually smaller. On March 1, 1908, four months after closing the tube, examination showed that the ear had become quite dry and clean, the polyp having entirely disappeared. He was kept under observation for a few weeks, and remained well during that time.

On March 5, 1910, two years later, he reappeared at my request for examination. He stated that he had not paid any attention to his ear during these two years, and upon examination the ear was found to be dry and clean, there was no sign of polyp and the edges of the drum-membrane had retracted so that they were nearly flush with the walls of the canal. The ossicles still remained.

Case 3. Male, 28 years old. The patient stated that he has had a discharge from his right ear for over a year, which resulted from an acute otitis, following a sea-bath. Upon examination a large perforation was found, involving about three-quarters of the drum; the ossicles were present.

On December 1, 1907, the tube was curetted. When the packing was removed on the following day, the inner tympanic wall was found swollen and red, and the discharge had assumed a thin watery character. The patient was in the habit of using instillations of boric acid solution, and he was allowed to continue them. The swelling of the mucous membrane lasted two weeks, but the ear

did not become dry until January 12, 1908, six weeks after closing the tube. The patient has not been seen since.

Cases 4 and 5. Male, 27 years old. The patient, who came under my care March 7, 1908, stated that both his ears had been discharging profusely since an attack of typhoid fever in his seventh year. Upon examination there was found a profuse discharge from both ears, muco-purulent in character, without odor. A large perforation existed in both drum-membranes, involving the lower two-thirds. There were no polypi, but the edges of the perforations were covered with granulations, especially in the upper part near the remaining hammer-handle.

The left tube was curetted in the manner described. On the following day, when the packing was removed, there was considerable swelling of the inner tympanic wall, with some redness. There was a discharge of thin, slightly turbid mucus. The ear was powdered with iodoform. One week later, on March 15, there was still some swelling of the inner tympanic wall and a discharge of thin watery mucus. On March 22, two weeks after operation, the ear had become dry and the swelling of the mucous membrane had disappeared. The granulations on the edge of the drum were reduced in size.

The patient was not seen again until February 5, 1910, two years after closing the tube. The ear which had been operated upon, the left ear, was found to be quite dry and free from secretion; the edge of the drum-membrane had healed completely, and the perforation had increased in size, so that the entire hammer-handle was exposed. The right ear was still discharging freely, and there was a mass of granulation tissue in the upper anterior part, just under the short process. The tube was curetted and the ear packed. On the following day there was a considerable reaction, the inner tympanic wall being swollen and pink in color. There was a discharge of thin watery mucus. The ear was powdered with iodoform. On February 16, there was still a slight amount of clear watery discharge, but the swelling had disappeared. On March 25, 1910, the ear was clean and free from pus, and upon wiping the middle-ear with an applicator, the cotton did not become moist; but the mucous membrane still had a moist appearance.

Cases 6 and 7. Annie B., 27 years old, came under my care October 6, 1908. Both ears began to discharge after measles at 9 years of age, and had been discharging profusely since, especially in damp weather. Both drum-membranes had completely disap-

peared, but the remains of the ossicles were present. Both tubes were curetted at one sitting. After the removal of the packing, the inner tympanic walls on both sides were swollen, but not reddened; the discharge was slight in amount, and consisted of clear mucus. On February 6, 1910, 16 months later, the left ear was dry and clean, the mucous membrane having the dry appearance of skin rather than of mucous membrane; the right ear contained a slight amount of clear mucus. The patient was in the habit of inserting a cotton-tipped toothpick into this ear, and wiping the canal, several times a day. When her attention was called to the harmfulness of this practice, she discontinued it, and the ear has since become dry.

Cases 8 and 9. Anna H., 45 years old, came under my care October 8, 1908, stating that both her ears had been discharging since childhood, as long as she could remember. About ten years ago she began to suffer from tinnitus and vertigo, associated with pains in the head on the right side. She then had an operation performed on the right ear, following which there was no change in the amount of aural discharge, nor in the other symptoms. Since that time she has been under constant treatment at various hospitals.

Examination showed a profuse foul-smelling discharge from both ears; both drum-membranes had disappeared, but the remains of the ossicles could be seen on both sides. Behind the right ear there was a scar from an ordinary mastoid operation not like the scar from a radical operation. There was no scar in the concha or canal wall. Ordinary conversation could be heard at six feet on both sides.

Both tubes were operated upon in the manner described. The packing was removed on the following day. There was considerable swelling of the inner tympanic wall, the color was pale red, with a thin serous discharge in both ears. October 15, both ears were free from discharge and the mucous membrane of the inner tympanic wall had resumed its normal appearance. The patient was not seen again until February 6, 1910, 16 months after closure of the tubes. No treatment of any kind had been carried out during the interval, yet both ears were dry and clean, the inner tympanic wall having the pale, dry appearance of skin rather than of mucous membrane.

Cases 10 and 11. Jennie P., aged 15, states that at the age of 2 years, double paracentesis was performed during an acute illness; following this there has been constant profuse discharge from both

ears, often accompanied by odor, which was not alleviated by local treatment at various clinics.

Examination showed that there was profuse purulent discharge in both ears. Both drum-membranes had disappeared, but remnants of the ossicles were present on both sides. On the right side there was a polyp of moderate size, filling about three-quarters of the lumen of the canal.

On October 8, 1908, the right ear was operated upon. Enough of the polyp was removed to expose the anterior region of the drum-cavity, and the tube curetted. When the packing was removed on the following day, the inner tympanic wall was swollen and somewhat red, and there was a thin mucous discharge in the ear, but no pus. The remains of the polyp was touched with 10 per cent solution of nitrate of silver.

Previous to the operation, the patient was in the habit of instilling peroxide of hydrogen into her ears, and she was allowed to continue this practice. She was seen twice a week, and the polyp was touched with the silver solution. It became gradually smaller, and the discharge remained of a mucous character.

On November 9, the left ear, which had continued to suppurate during this time, was operated upon. The operation was followed by the same reaction as occurred in the right ear, and lasted about two weeks. The polyp on the right side disappeared completely after two months, but both ears continued to secrete turbid mucus until the beginning of April, 1909, when both ears became dry; the inner tympanic wall on both sides now had the smooth dry appearance of skin. The ears have remained dry since then.

Case 12. Ernest B., 11 years old, has had discharge from both ears for the last five years, following scarlet fever. In the left ear the drum-membrane had disappeared entirely, but the discharge was only slight and disappeared promptly upon local treatment. In the right ear there was a perforation in the posterior inferior quadrant, involving about one-quarter of the drum-membrane; with it a continuous discharge of pus, which was usually quite abundant and occasionally had an odor, resisting continuous treatment at the hands of skilled specialists. Local treatment, including the irrigation of the tube through the catheter, succeeded in reducing the amount of the discharge and freeing it from odor, but it could not be made to disappear entirely. Attempts to close the perforation with trichloracetic acid also failed. Radical operation was refused.

On October 15, 1908, the tube was curetted in the manner described. The same reaction followed which has been described in the other cases, and after three weeks, the ear became dry and clean. The perforation in the drum-membrane became gradually larger, until after a few months it included nearly the entire drum-membrane. The ear has remained dry up to the present time.

Case 13. Rebecca S., aged 19, stated that her left ear had been discharging since early infancy. During the past four years the discharge assumed a creamy consistency, became very profuse, and frequently had a foul odor. There was occasional tinnitus, and vertigo occurred upon slight provocation, especially upon attempting to syringe the ear. The hearing, however, had remained good.

After cleansing the ear, examination showed that the inner part of the canal was filled with a polyp, so that the middle-ear could not be seen. An application of strong cocaine and adrenalin solution caused the polyp to shrink, so that it occupied the posterior half of the tympanic cavity. It was attached by a broad pedicle to the posterior inferior part of the promontory. Owing to the presence of vertigo, and the location of the polyp, its removal was deemed inadvisable and as the anterior part of the middle-ear cavity was exposed by shrinking the polyp with cocaine; its removal was unnecessary.

Examination of the anterior part of the cavity showed that a cicatricial adhesion had formed across the tubal orifice, shutting off the tube from the middle-ear. A bougie, passed into the tube, was stopped by this membrane, and could be seen under it. When this membrane was incised, a drop of pus escaped; and the presence of a fistulous tract could be determined, running from the Eustachian tube along the floor of the middle-ear as far as the posterior wall. The introduction of the salpingeal probe disclosed the presence of carious bone on the floor of the tube and along the hypotympanum.

The entire tympanic portion of the tube from the isthmus outwards was thoroughly curetted with the salpingeal curette, the carious bone on its floor being carefully removed, as well as the carious bone on the floor of the middle-ear. The ear was then dusted with iodoform powder, and packed.

When the packing was removed on the following day, the ear was filled with a purulent discharge of a much thinner consistency than before the operation, and the inner tympanic wall was swollen

and red. The polyp was again shrunken with cocaine and the silver solution was again applied. This was repeated every few days, the polyp becoming rapidly smaller, and the amount of the discharge becoming less.

Six weeks after operation there was only a slight amount of secretion in the ear, but this was of purulent character; the polyp had shrunken until all that was left of it was a small nodule on the promontory. Examination now showed that the pus came from the region of the attic, the Eustachian tube being closed, and the floor of the tympanum quite healed. The use of the intratympanic mirror disclosed the presence of a black mass in the attic, just internal to the short process, which was exceedingly painful to the touch and felt hard and bony to the probe. It was evidently the incus, in a necrotic condition. Operation for its removal was proposed but was refused. The ear was treated by insufflation of dry powders, at interval for three months, when the patient awoke one morning with a sharp pain in the ear followed by an increase of the discharge, which all that day was tinged with blood. When the ear was seen on the following day, it was found that the black mass had disappeared from the attic. The probe could be moved about freely in the attic, and pain was elicited only in the neighborhood of its outer wall.

The discharge now began to diminish rapidly but a small crust continued to form near the short process, upon the removal of which a small drop of pus escaped. At first this crust would re-form in a few days, but the interval became gradually longer; the last crust was removed in the early part of January of this year, and it has not reappeared since.

The ear is now entirely free from secretion, the inner tympanic wall having assumed the dry appearance of skin. The point on the promontory from which the polyp had grown has become converted into a shallow pit or depression. The tinnitus has disappeared and vertigo is only occasionally present. The hearing remains as good as before the operation.

Case 14. Tony O., aged 27 years, stated that her left ear had been discharging since childhood, from causes unknown to her. The discharge was usually quite abundant and occasionally there was an odor. Examination showed a profuse discharge, purulent in character. The drum-membrane had nearly disappeared, but remnants of the ossicles were present. A small polyp, as large as a pea, was attached to the malleus, near the short process. The polyp

was removed with the snare, but as it returned in a few days, the ossicles were removed, together with the outer attic wall, under local anesthesia, on July 24, 1909. The tube was then curetted and the ear dusted with iodoform, and packed. On the following day the inner tympanic wall was swollen and slightly congested, and there was a thin mucous discharge in the ear. The swelling of the inner tympanic wall lasted about ten days when it receded and the ear became dry. It has remained so since.

Case 15. Elsa H., 30 years old, stated that her left ear had been discharging since childhood. The ear was neglected until about 5 years ago, when she came under the care of a competent otologist. Radical operation having been refused, she was put under conservative treatment, which resulted in diminishing the amount of the discharge, especially during the warm weather. In the winter the discharge was always profuse, purulent, and usually had a bad odor. The hearing was considerably diminished, whisper being audible at four inches. Examination showed that the upper half of the drum-membrane had disappeared, but the remains of the ossicles were still present. The lower part of the drum-membrane had become adherent to the promontory; anteriorly, this adhesion terminated in a small opening, by which the space underneath communicated with the middle-ear proper, while posteriorly the adhesion extended as far as the aditus ad antrum. A bougie passed through the Eustachian tube could be seen under the adherent membrane.

On November 8, 1909, the ear was operated upon. The adhesion was severed by an incision extending along its entire length. A small amount of pus escaped. This was wiped away, especially in the region of the round window, when it was found that the hearing-distance had improved so that whisper could now be heard at a distance of 6 feet. The tube was curetted, the ear dusted with iodoform, and packed. On the following day the inner tympanic wall was swollen, and there was a discharge of thin mucopurulent secretion in the middle-ear. This reaction persisted for 3 weeks, when the swelling had completely subsided and the ear had become dry, and has remained so since. The adhesion in the lower half of the drum has not returned. The edges of the incision have completely retracted, so that the hypotympanum is freely exposed. The gain in the hearing which was made at the time of the operation has been maintained up to the present time. The patient has since had an acute empyema of the antrum of Highmore, without affecting the ear.

Case 16. William K., 21 years old, stated that he had had a constant, profuse discharge from his ear for the last 14 years, usually with a foul odor. The tube was curetted on May 6, 1909. On the following day the mucous membrane of the inner tympanic wall was swollen and the discharge was slight and mucous in character. On May 11, the swelling had gone down, but there was still some discharge of clear watery mucus.

The patient has not been seen since, but I had a communication from him on March 5, 1910, when he stated that his ear had remained entirely free from secretion during the summer, but after a sea-bath a slight discharge again appeared for a few days. During the following winter there has occasionally been a slight amount of moisture, but it did not persist for more than a day or two at a time.

Case 17. A. B., a man 19 years old, stated that his right ear had been discharging since early infancy, following an attack of measles. The discharge was profuse and, when it was neglected, would acquire an offensive odor. He had been under treatment at intervals all his life.

Examination showed that the entire drum-membrane had disappeared; the remnants of the ossicles were present and felt carious to the probe. There was some granulation tissue around the orifice of the tube.

On April 4, 1909, the necrotic ossicles, together with a part of the external attic wall, were removed under local anesthesia, and the tube curetted at the same time. On the following day, when the packing was removed, the inner tympanic wall was found very much swollen, and there was some blood in the middle-ear. This was removed and the ear dusted with iodoform powder. On the next day there was some discharge in the middle-ear, but it was not purulent, but consisted of slightly turbid mucus. The swelling of the mucous membrane continued until one week after the operation, but slight moisture continued to collect in the ear for 4 weeks, when the ear became dry and clean, and the mucous membrane had assumed the appearance of skin.

During the following summer the patient was in the habit of bathing daily in the public bathing places near the city, but paid no attention to his ear. In the fall a slight discharge reappeared, but lasted only one week. It reappeared, however, during the winter every 6 or 8 weeks, lasting each time for a few days.

On February 5, 1910, the patient appeared at my office with such a recurrence of two days' standing. There was a small amount of muco-purulent secretion in the middle-ear. On wiping this away, it could be seen that an adhesion had formed in the upper anterior corner of the tympanic cavity, behind which a small pocket had formed, which contained pus. This was incised; the ear became dry in two days, and has remained so since.

Case 18. Sadie F., 17 years old, came under my care September 18, 1907. She stated that her left ear had been discharging since she was 2 years old, following measles. The discharge was usually very abundant and generally had a very foul odor.

Upon examination, the drum-membrane was found to have disappeared entirely, together with the ossicles, but a remnant of the hammer-handle could be seen attached to the outer wall of the attic. There were several small masses of granulation tissue around the margin of the drum-membrane. In the upper wall of the canal, at about its middle, there was a round opening which was filled with white cheesy masses. Upon removal of this material, the opening was found to lead to a large cavity in the region of the antrum, about as large as a hickory nut. Examination of the contents of this cavity showed that it consisted of epithelial cells and detritus, and an occasional crystal of cholesterin. It was therefore evident that this was a large cholesteatomatous cavity. The tube was cu-retted in the manner described, and the ear packed. Two days later the inner tympanic wall was found to be swollen and edematous and slightly red, and the cholesteatoma cavity had partly refilled. Irrigations of 1 to 5,000 solution of bichloride of mercury were ordered. The patient returned on September 31, when the ear was found clean and nearly dry, and the large cholesteatoma cavity was empty. On October 6 the ear was quite dry and clean. The patient was not seen again until February 2, 1910, 2 years and 4 months after closing the tube. During this time the ear had been neglected, although there was occasionally some moisture in the canal. Upon examination a plug of cerumen was found in the canal, upon the removal of which it was seen that the cholesteatomatous cavity was empty and its walls dry. It was considerably smaller than when last seen. The inner tympanic wall was not quite dry; upon touching it with a cotton applicator, the applicator became slightly moist, but there was not sufficient fluid to constitute a distinct drop. The granulation-tissue on the edges of the drum-membrane had entirely disappeared, the walls of the middle-ear cavity passing smoothly into those of the canal.

Case 19. Rose L., aged 50, states that $1\frac{1}{2}$ years before she came under my care a paracentesis was performed on her right ear for acute otitis media. The discharge which followed has never ceased, but has remained profuse and of a purulent character. A perforation involving about one-quarter of the drum existed in the lower part, the upper border of which embraced the handle of the malleus. She had been under constant local treatment without any result. As the upper border of the perforation was too low to permit the introduction of the instruments into her tube, a small incision, about 2 mm. long, was made in the upper border of the perforation near the anterior margin of the drum. On October 24, 1907, the tube was curetted. On the following day there was swelling of the mucous membrane of the inner tympanic wall, and a discharge of thin, slightly cloudy fluid. The swelling of the inner tympanic wall lasted three weeks, when it disappeared, and the discharge became less abundant. On November 17 there was still a very slight amount of moisture which could only be recognized by inserting an applicator. This condition persisted for a year, when the patient passed out of observation.

Although this ear did not become entirely dry, the behavior of the perforation is of special interest. After the upper border of the perforation was incised there remained on each side of the incision an angular-pointed tab of tissue. A week after the operation these tabs became rounded and finally merged into the general margin of the perforation. The perforation itself began gradually to enlarge, so that after a year it involved the greater part of the drum-membrane.

Case 20. Henrietta R., aged 23, stated that her ear had been discharging for the last 7 years, following an acute inflammation of the auricle and the side of the face. Examination showed that the entire drum-membrane had disappeared, the middle-ear and canal being filled with purulent secretion. After irrigation, a number of small granulomata were seen in the neighborhood of the tubal orifice. The tube was curetted and the granulations removed, November 16, 1907. After the reaction from the operation had passed away, the discharge of pus ceased, but a slight amount of clear mucus continued to be secreted in the ear as long as the patient remained under observation, February 10, 1908. The patient has not been seen since.

Case 21. Anna S., 21 years old, stated that her left ear had been discharging since early childhood, the secretion being very profuse

and often with foul odor. Examination showed that secretion was purulent in character, the drum-membrane and ossicles having entirely disappeared. The tube was curetted, in the manner described, on January 17, 1908. The discharge became very much less after the operation, and on February 11, 1908, had almost ceased. The patient was not seen after this date until February 5, 1910, when she stated that her ear had remained free from discharge for two months, after which it became as abundant as before the operation, and has continued so ever since.

Examination showed that a cicatricial drum-membrane had formed which nearly closed the middle-ear cavity, the opening in the membrane being about as large as the head of a pin. On testing the tube, by filling the canal with water, and inflating air through the Eustachian catheter, it was found that the tube was open; in other words, the operation performed two years ago had not succeeded in causing atresia of the tube. For a short time after the operation, while the mucous membrane of the tube was swollen, the discharge was lessened; as soon as the swelling subsided and the tube became patent, the discharge returned in its former intensity, and a cicatricial membrane had formed.

A second operation was therefore performed on February 14, 1910, but the cicatricial drum-membrane was not incised nor was the opening in it dilated. The reaction which followed was the same as had occurred in the other cases; the discharge on the following day was clear mucus. On February 21, the swelling of the inner tympanic wall had subsided, and the opening in the cicatricial drum-membrane had become considerably larger. On February 28 the opening in the membrane measured 5 mm. in diameter, about 3 times its original size. On March 20, the perforation measured about 7 mm. in diameter, so that the cicatricial membrane was reduced to a band of tissue around the canal wall not more than 2 mm. wide. The discharge has been reduced to a minimum. No treatment of any kind is carried out by the patient, and when she makes her weekly visits to my office, only a slight amount of secretion is found on the floor of the middle-ear.

In reviewing these cases, it must first be noted that no injurious results were caused at the time of the operation nor did any follow afterwards. The operation is painless under cocaine anesthesia, and only a few of the patients complained of post-operative pain. The operations were performed in the office, and the patients allowed to go home afterward. The hemorrhage at the time of the operation

was very slight, only a few drops of blood being lost, and there were no secondary hemorrhages. Swelling of the pharyngeal portion of the tube did not occur, nor was there any rise of temperature or any evidence of sepsis in the tube. Tinnitus did not follow in any of the cases, and when present before the operation was not increased afterwards. The hearing, which was tested by speech only, was neither improved nor diminished to a noticeable degree, the improvement which followed in one case being attributable to other causes.

My object in performing this series of operations was not to study the possibilities of conservative treatment of aural suppuration, but to determine, in as logical a manner as is possible in medicine, the exact influence which would be exerted upon the suppurative process by causing a permanent atresia of the Eustachian tube at the isthmus, and only such intratympanic surgery as was absolutely necessary was performed at the time of closing the tube. When the tube had already been closed, or partly closed, by adhesions at the tympanic orifice, these adhesions were cut, and the lumen of the tube obliterated at the isthmus. Ossiculectomy was done in two cases only. When polypi were present, and were so large that even after the use of cocaine and adrenalin they still obstructed the view of the tubal region, enough of the polyp was removed to expose the field of operation. For the polypi which occur in aural suppuration are not true mucous polypi, but are merely exuberant granulations such as occur in bone-suppurations elsewhere in the body, and like these are amenable to treatment by astringent applications, especially after the infectious process has ceased. Such polypi were therefore treated by applications of 10 per cent solution of nitrate of silver. Most of the patients had some favorite method of treating their ears, such as the use of irrigations, instillations, etc., and they were allowed to continue the same form of treatment, more as a placebo than for any other reason. We may therefore state with logical accuracy that the results obtained were directly caused by closing the tube at the isthmus, and by this alone.

The suppuration had existed in all of the cases for a long time. In one case for a year, in one for $1\frac{1}{2}$ years, in a boy of 11 for 5 years; in the rest, all adults, since childhood. In all of the cases the closure of the Eustachian tube at the isthmus was followed immediately by a marked diminution in the quality of the secretion, a fact which in the opinion of the writer, proves the statement

made above, that in cases of profuse aural discharge the largest part of the bulk of the secretion is not formed in the middle-ear, or mastoid cells, but is derived from the naso-pharynx. Atresia of the tube was successfully accomplished by the first operation in all of the cases but one.

Of the 21 cases operated upon 13 were cured. Of these 12 were examined within the past month, and were found to have remained well, 2 for 3 months, 1 for 7 months, and the rest from 1 to 2 years.

Of the 8 cases which were recorded as not cured, 2 were operated upon in the spring, and in both the discharge ceased completely at the time. During the summer, however, they indulged in sea-bathing in the public bathing places, and recurrence took place. The amount of secretion was very slight and ceased readily upon local treatment.

Another patient was in the habit of inserting a cotton-tipped tooth-pick into her ear to see if it was discharging. The secretion which was present consisted of clear mucus, and when she was ordered to discontinue this practice, the ear promptly became dry.

The fourth case was the one with the large cholesteatoma cavity. This cavity has been free from cholesteatoma for $2\frac{1}{2}$ years, but there is still a slight amount of pus which can be obtained by wiping the floor of the middle-ear with an applicator.

In the fifth case the operation is of such recent date that it is too early to present results.

In the sixth case atresia of the tube was not accomplished, and recurrence was complete. The case is of special interest, however, because during the time that the patient was not under observation, a cicatricial membrane had formed, which disappeared spontaneously after the tube was closed by a second operation.

The remaining two cases did not reappear for observation, and their condition is unknown.

The operation was followed in practically all of the cases by two peculiar and interesting phenomena. The first of these is the swelling of the inner tympanic wall. This swelling was sometimes quite marked, so that it filled the entire middle-ear, but the mucous membrane never had the intensely red appearance of acute inflammation. There was frequently enough congestion to give it a pink color, but the swelling had more the nature of edema than of inflammation. Moreover, the swelling did not occur in the canal wall near the tympanic orifice, nor in the pharyngeal portion of the tube; it was not, therefore, the edema which might occur with any

traumatism, for it was limited entirely to the inner tympanic wall. Furthermore, the swelling always lasted for one or two weeks, and was accompanied during the whole of this time by a watery secretion; for the discharge which appeared in the ear during this time was either a thin, watery mucus or a diluted sero-purulent fluid.

These conditions might be considered to be of trophic or of vaso-motor origin, for the plexus of sympathetic nerves which surrounds the carotid artery sends a few fibres through the floor of the bony part of the tube, where they unite, under the mucous membrane with the tympanic branch of the glosso-pharyngeal and with the lesser superficial petrosal nerve, to form the tympanic plexus in the anterior part of the inner tympanic wall. These nerves are undoubtedly injured by the operation. On the other hand, it has been shown (A. Most, *Arch. für Ohrenh.*, Vol. 164, p. 241) that the lymphatics of the inner tympanic wall pass through the Eustachian tube and empty, together with those of the naso-pharynx into the deep cervical lymph glands. These lymphatics are injured by the operation, and the lymphatic stasis so caused would account for both the swelling and the transudation of serum. With the establishment of a collateral lymph circulation, both of these conditions disappear.

The second phenomenon of interest is the behavior of the drum-membrane. In all the cases in which the perforation involved only a part of the drum-membrane, the perforation invariably became larger after the operation; the edges of the drum-membrane became thinner and thinner, and gradually retracted toward the walls of the canal, so that after a month or two, all that remained of the drum-membrane was a narrow, white line. The ossicles, however, remained. The perforation never became smaller or showed the slightest tendency to close, but always became larger. The only case in which a cicatricial membrane did form, and in which it nearly closed off the middle-ear from the canal, was the case in which the tube remained open; as soon as the tube was closed by a second operation, the opening in this cicatricial membrane immediately began to grow larger, and the membrane eventually disappeared. In the case in which the structure was cut, the incision in the drum retained its linear form and showed no sign of granulating as long as the tube was closed by swelling of its mucous membrane; as soon as the tube became patent, the perforation immediately began to granulate, became round in form and soon closed entirely.

This tendency of the drum-membrane to spontaneous atrophy after the tube has been closed, might be attributed to a trophic

disturbance caused by the destruction of the sympathetic nerves in the floor of the tube; but there is no evidence to prove that the trophic nerve-supply of the drum-membrane is contained in these fibers. On the other hand, the writer fully believes that one of the important functions of the drum-membrane is to protect the middle-ear against infection from the naso-pharynx, in fact, this is the only function for which the drum is indispensable. When the lumen of the tube has been obliterated by organic atresia at the isthmus, the necessity for this protection no longer exists. Hence, in accordance with general physiological law, when the function of the drum-membrane has been abolished, the organ itself becomes atrophic.

Whatever may be the theoretical explanation, the fact remains as a matter of clinical observation, and it may be formulated into the rule or law, which is here propounded for the first time, namely: *When the Eustachian tube has been permanently closed by organic atresia at the isthmus, a perforation in the drum-membrane will never close, but will tend to become larger.* The fact that there are other reasons why a perforation in the drum-membrane may remain open does not in the least conflict with this rule.

Otosclerosis: It is a well-known fact that there are certain cases of otosclerosis in which the hearing is improved when a perforation is made in the drum-membrane. Some writers have stated that this happens only in those cases in which the drum-membrane is very much thickened; but this statement has not been borne out in my experience. On the other hand, Lucae, who has performed many of these operations, states that benefit may usually be expected in those cases in which the defective hearing is accompanied by a negative Rinné test.

At several different periods in the history of otology, the attempt has been made to give such patients the benefit of the improved hearing so attained, but these operations have been abandoned because, however brilliant the results were immediately after the operation they did not remain permanent. The failure to maintain the improved hearing may be ascribed to three causes. In the first place, it was usually difficult and often impossible to keep the perforation open, in spite of the variety of methods employed and of the many ingenious devices which were invented for the purpose; even when the entire drum-membrane, together with the ossicles, were removed, cicatricial closure occurred in one-third of the cases within one year (Lucae). In the second place suppuration invariably set in sooner or later. In the third place, the procedure did

not exert any favorable influence on the disease itself, for the morbid process in the bone continued to advance in its usual course.

Now, from the experience which the writer had with the cases of chronic suppuration, he was led to believe that these three causes for failure could be avoided, if, after perforating or removing the drum-membrane, the Eustachian tube were closed at the isthmus, in the same manner as was done in the suppurating cases. For he was convinced that by closing the tube the tendency of the perforation in the drum-membrane to close would be overcome. Secondly, he was satisfied that suppuration would be prevented by the same means. And, thirdly, if the same lymphatic stasis occurred in the otosclerotics which took place in the suppurative cases, and if it were followed by the same dessication of the inner tympanic wall, it did not seem impossible to him that the marked changes which would be produced in the circulation of the parts, might exert a direct influence upon the diseased process itself; but he realized that the nature of this influence, whether favorable or unfavorable, could only be determined by the behavior of the hearing-power subsequently to the operation.

The first case to be operated upon in this manner was a woman, 60 years old. She gave a distinct family history of hereditary deafness extending through several generations. Her own hearing had become gradually poorer since early adult life. There was marked tinnitus, humming in character, in both ears. Upon examination it was found that the hearing was markedly diminished on both sides, whisper and ordinary conversation being inaudible. Loud conversation, close to the ear, was heard, more distinctly on the left side than on the right. Hearing for all tuning-forks was diminished for both bone-and air-conduction, but the Rin   test was negative. The drum-membranes were thin and atrophic, somewhat retracted, and the ossicles were immovable. The right ear was operated upon on May 15, 1909. A probatory incision was made in the posterior inferior quadrant in the region corresponding to the round window, so as to admit the sound vibrations as directly as possible to this region. There was an immediate improvement in the hearing, as whisper could now be heard close to the ear.

The entire drum-membrane was then removed, including the malleus, but the incus was left in situ. The tube was then thoroughly curetted, the ear dusted with iodoform and packed. When the packing was removed on the following day, the inner tympanic wall was very much swollen, so as to fill the entire middle-ear cavity; it was pink in color; there was a secretion of thin watery fluid on the

floor of the canal. This reaction persisted for 3 weeks, after which the ear became dry and the swelling of the inner tympanic wall had completely receded.

In the middle of July, 2 months after the operation, the hearing had so improved that whisper could be heard at 2 inches and ordinary conversation at 10 inches. On November 3, whisper 3 inches, ordinary conversation 15 inches. It is now a year since the operation. The tinnitus in this ear has entirely disappeared. Not only has the patient kept the gain which resulted immediately upon opening the drum-membrane, but she has made additional gains since then, and the improvement is still going on. There has been no discharge from the ear at any time, the tympanic cavity being dry and clean. The opening in the drum-membrane has not shown the slightest sign of becoming smaller.

The second case was a girl, 25 years old, a daughter of the first patient. She stated that her hearing had been diminishing for about 5 years. She was under my care for some time previous to the operation. At first her hearing was markedly diminished for all tuning-forks, especially for the low ones. Rinné negative. Whisper, right ear 12 inches, left ear 3 inches. Occasional tinnitus especially left. There was considerable swelling of the tubal mucous membrane on the left side, as only a small bougie could be passed. The tube was dilated with the sound and applications of argyrol made to it, with the result that the hearing improved so that whisper could be heard at 24 inches. This result was not constant, however; the maximum hearing-distance varied from 16 to 24 inches, but could never be extended beyond the latter figure. On July 24, 1909, a probatory incision was made, when the distance for whisper increased to 3 feet. The drum-membrane and malleus were then removed, and the tube curetted. The reaction lasted about 2 weeks. Six weeks after operation, the hearing-distance for whisper had increased to 4 feet. Three months later, a further improvement had taken place, whisper being distinctly audible at 5 feet. In March, 1910, the distance was 6 feet.

There has been no discharge from the ear at any time, the tinnitus has entirely disappeared, and the perforation in the drum-membrane has shown no sign of becoming smaller.

The third patient was a man 38 years old, who had noticed increasing deafness for a number of years, for which he had been treated both here and abroad, without result. When he came under my care, in January, 1907, his hearing was very much reduced, for

all forks, both by bone-and air-conduction, but the Rinné test was negative. Whisper could be heard in the right ear at 3 inches, in the left ear at 12 inches. Both ear drums were thin and transparent, and the promontory could be clearly seen through it (Schwartz's symptom). The ossicles were retracted and immovable. There was some tinnitus. The Eustachian tube was wide-open and inflation had no effect on the hearing. The only method of treatment which was of any benefit, was the use of Lucae's pressure probe. Direct massage of the ossicles diminished the tinnitus and improved the hearing so that in the right ear he was able to hear whisper at 15 inches, in the left somewhat further; but in spite of his patient endurance of this form of treatment for a long time, no further advance could be made.

On November 5, 1909, it was decided to make a probatory incision in the drum-membrane; his hearing distance was immediately doubled, to 30 inches. The drum-membrane was then removed, and the tube curetted. When the reaction, which lasted nearly a month, had subsided, his hearing distance for whisper in the operated ear was 8 feet.

Although these cases are few in number, they indicate clearly that the destruction of the mucous membrane of the isthmus of the tube in cases of otosclerosis is followed by the same disturbance of the lymphatic circulation of the inner tympanic wall as occurs in the suppurative cases, and that when the swelling and transudation spases off, the same dessication of the mucous membrane occurs. From the fact that these patients not only retained the increase of hearing which immediately succeeded the operation, but that they made additional gains afterwards, one case continuing to improve after one year, as well as from the fact that the tinnitus disappeared in all 3 cases, it seems to the writer that he is justified in drawing the conclusion that the changes produced in the inner tympanic wall have exerted a direct and favorable influence upon the otosclerotic process itself. If this conclusion is verified by similar results in other cases, it may indeed be true that a ray of hope may be extended to those sufferers whose unfortunate condition is the *bête noire* of otology.

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STATUS THYMO-LYMPHATICUS AND ITS RELATION TO SUDDEN DEATH.*

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Adults and children with the condition known as status thymo-lymphaticus are especially liable to die from infectious disease, and are particularly subject to death from shock and death from anesthesia.

The term status thymo-lymphaticus, or status lymphaticus, is applied to people who present hyperplasia of the thymus gland, lymph-nodes, tonsils, lymphatic elements of the spleen and intestinal tract, and lymphoid marrow of the long bones. Associated with this condition are often found hypoplasia of the heart and arteries, evidences of infantilism, signs of old or recent rickets, abnormalities of the thyroid gland, idiopathic epilepsy (Ohlmacher), acromegalia, Addison's disease and myxedema. There are many grades of status lymphaticus from cases showing simple hyperplasia of the thymus to those exhibiting extreme enlargement of this gland with pronounced hyperplasia of all the lymphatic elements of the body.

There is considerable doubt that status thymicus and status lymphaticus are identical conditions. Adami and Nicholls state that they personally regard the thymus as a lymphatic organ. According to Hart, the newer investigations of Wiesel and Hedinger tend to prove that the two are essentially different phenomena. In pure status lymphaticus there is present a *hypoplasia* of the chromaffin system, especially in the adrenals, analogous to that found in Addison's disease. In pure thymus hyperplasia, on the contrary, the chromaffin system is always well-developed. Again, the thymus is developmentally an epithelial organ, derived from the hypoblast of the third visceral cleft. The epithelial elements gradually atrophy, the sole representatives of their existence being the Hassall bodies, which are supposed to be due to the coalescence of the epithelial remnants. The structure is finally substituted by vascular connective tissue from which the lymphoid elements are derived (Adami and Nicholls). Thus the thymus at birth consists

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largely of lymphatic tissue like that of the lymph-nodes, spleen and other organs of the lymphatic system.

For the purpose of this paper we shall speak of status thymicus and status lymphaticus as identical, using the terms status lymphaticus or status thymo-lymphaticus synonymously. Perhaps future investigators may throw light on this interesting problem.

NORMAL WEIGHT OF THYMUS. The question as to the normal weight of the thymus at different ages is a much-mooted one. Hammar believes that the thymus undergoes rapid involution in both acute and chronic illnesses. In death from disease, he claims that the organ is often reduced to one-twentieth or more of its normal weight. In support of this view Hammar quotes Johnson, who reports that four days' starvation of dogs diminishes the thymus to two-thirds its normal weight; while thirty days chronic underfeeding brings about a thymus weight of one one-hundredth of the normal. Below are given figures for the normal weight of the thymus at different ages, taken from Hart:

HAMMAR.		FRIEDLEBEN.		VON SURY.	
	Grams		Grams		Grams
For new-born	13.26	1-9 months	20.7	New-born	14.4
1-5 years	22.98	9-24 "	27.3	Child in 1 month	15.
6-10 "	26.10	2-14 years	27.	2-9 month	24.3
11-15 "	37.52	15-25 "	22.1	9 months-2 year	23.2
16-20 "	25.58	25-35 "	3.1	2-14 year	25.8
21-25 "	24.73				
26-35 "	19.87				
36-45 "	16.27				
46-55 "	12.85				
56-65 "	16.08				
66-75 "	6.00				

Table of Average Weight of Thymus Gland.

Thus we see that the average weights obtained by Hammar are much greater than those of Friedleben and von Sury. Hammar attributes this to the fact that his material is taken from one hundred and twenty-six individuals who died while in complete health from accidental causes. On the contrary, von Sury's figures, which practically agree with Friedleben's, were taken from children who died from acute and chronic diseases.

According to von Sury and Friedleben the greatest weight of the thymus (27 g.) is attained at the end of the second year; while Hammar's statistics place the maximum weight (37 g.) between the eleventh and fifteenth years. The latter view, which is more probably correct, is substantiated according to Hammar, by observations conducted by Söderlund and Backman. It was found that the height of the thymus curve was reached in dogs at the end of the fourth month of life, at the time when spermatogenesis be-

gins. This period in dogs corresponds to the period of puberty in men (eleven to fifteen years).

In passing, it is interesting to note that Hammar believes the weight of the thymus gland as a whole is no criterion for estimating the amount of parenchyma of the organ, which is the functionating part. For example, at the ages of one to five years an average thymus weight of about twenty-three grams corresponds to a parenchyma of about twenty grams. At the ages of twenty-one to twenty-five years, the average weight of twenty-five grams has a parenchyma of scarcely five grams.

As far back as 1889, Paltauf of Vienna called attention to the fact that status lymphaticus was responsible for sudden death from shock and immersion in cold water, and that the subjects of this condition bore chloroform anesthesia badly. His writings acted as a stimulus to investigations in this field; until now numerous instances are on record. Paltauf reported the case of a twenty-year-old factory worker swimming with his companions in a stream, who suddenly shrieked, sank under water, and was brought up almost immediately a corpse. Autopsy showed a thymus ten centimeters long, one centimeter thick, five to six centimeters broad; contracted aorta, heart fairly large and pale. Lymph-glands and spleen enlarged and pale. Adenoid tissue of naso-pharynx and base of tongue hypertrophied. Paltauf reported a case of Nordmann's somewhat similar to the one just quoted. A twenty-year-old recruit went swimming before his mid-day meal. After a few minutes in the water he returned to the shore, had a chill, and fell to the ground, rolling his eyes. In spite of attempts to resuscitate him, the young man quickly died. Autopsy revealed dark fluid blood, edema of the lungs, congested internal organs, hyperplasia of the thyroid, faucial and lingual tonsils, lymph glands and spleen. The thymus was the size of a man's fist.

During the past year the writer has seen several reports of sudden deaths from the subcutaneous injection of diphtheria antitoxin, where the patients were said to be subjects of status lymphaticus.

Recently there have been a large number of autopsies in New York at the City Morgue, upon workmen who have died of Caisson disease. In many of these status lymphaticus was present. It is highly probable that status lymphaticus increases the liability to sudden death in compressed-air workers.

SUDDEN DEATH FROM ANESTHESIA. Of great interest to the surgeon is the relation of status lymphaticus to death from

the use of both general and local anesthetics. Blake has reported seven cases, operated upon in Roosevelt Hospital in one year, who died during or shortly after ether necrosis, where the only discoverable cause of death was status lymphaticus. Hart mentions the following fatalities due to status lymphaticus in connection with the use of general anesthesia:

1. Laquer's case, a fourteen-year-old boy operated upon for the enucleation of an eye-ball.
2. Michl's case, three-quarters of an hour chloroform narcosis; ear operation. Patient suddenly became asphyctic, Cheyne-Stokes respiration, death.
3. Ploc saw a sixteen-year-old boy die suddenly at the beginning of narcosis.
4. Lecène saw a man thirty-two years old, who, after incision of a bubo under general narcosis, suddenly died while apparently in the best of condition. Weight of thymus, thirty-five grams.
5. Katholicky had a female patient forty-six years old, upon whom a herniotomy was performed under chloroform narcosis, who died suddenly four days after operation, apparently from heart collapse. Dimensions of thymus 8x7x2 cm.
6. W. J. McCardie collected a series of thirty fatalities. The anesthetic was chloroform 17 times, ether 6 times, a mixture of chloroform and ether 5 times. Two were doubtful cases, the anesthetic being nitrous oxide gas.

7. Under local anesthesia three deaths have been recorded: (a) Horoszkiewicz, quoted by McCardie—Tropocaine, 0.075 gm. injected locally for the removal of a small cyst of the neck. (b) T. J. Harris' case of tonsilotomy, cocaine anesthesia. The operation was quickly performed. It was almost immediately followed by syncope and death. The patient was an adult. Autopsy revealed a thymus weighing eighteen grams. (c) H. Nettel's case of a woman thirty-four years old, Schleich's infiltration anesthesia for the removal of an exophthalmic goiter. Autopsy—Status lymphaticus with enormous hyperplasia of the entire lymphatic apparatus.
8. Warthin reported the case of a woman forty-one years old, who died suddenly during anesthesia. Status lymphaticus. Persistent thymus—Cardiac death. Microscopically "lymphoid exhaustion of lymph-nodes and spleen."
9. Roberts records the case of a twenty-three-year-old woman who died three minutes after the administration of two drams of bromide of ethyl for the extraction of a tooth. Autopsy showed status lymphaticus, the thymus measuring $3 \times 2\frac{1}{2} \times 3\frac{3}{8}$ inches.
10. L. M. Hurd performed an adenoid and tonsil operation upon a negro child $2\frac{1}{2}$ years old under ether anesthesia, who was returned to the ward from the oper-

ating room in good condition. The child died suddenly twenty-five minutes after operation. Autopsy demonstrated a large thymus covering the whole anterior surface of the heart and great vessels, also hyperplasia of lymphatic system. The larynx, trachea and bronchi contained no evidence of blood clot.

These reports demonstrate conclusively that chloroform is the most dangerous anesthetic to use if status lymphaticus exists. In adenoid and tonsil operations, especially, chloroform should be avoided.

Notwithstanding the fact that many eminent authorities deny the existence of thymic asthma and thymic death due to mechanical pressure of the enlarged thymus gland upon the trachea; yet this undoubtedly occurs. Jackson reported a case of thymic asthma which well illustrates this type. A boy four years old was brought to him for the relief of dyspnea and stridulous breathing, steadily increasing since an attack of croup six weeks before. Tracheotomy failed to relieve the dyspnea, it being necessary to pass a long bronchoscopic tube to get by the obstruction. By direct inspection the walls of the trachea were seen to be collapsed from before backward. The performance of thymectomy relieved the dyspnea permanently. The enlarged thymus gland was demonstrated by radiography before operation.

In view of the paucity of our knowledge concerning status lymphaticus, the following cases may be of interest. All but one are taken from the Bellevue Hospital Pathological Department Records. I wish to acknowledge my indebtedness to Dr. Charles Norris, the director of this laboratory, for permission to publish the following notes:

CASES OF STATUS LYMPHATICUS.

Case 1. Italian child, seven months old. Brought to New York Post-Graduate Hospital because of dyspnea and cyanosis. Second day of illness began to cough, and breathing became labored. Nurse in attendance suspected foreign body in air passages from actions of child. Third day auscultation revealed a few subcrepitant râles at bases of lungs. Temperature rose, and child died. Autopsy: Broncho-pneumonia; dilatation of the heart; congestion of meninges; cloudy swelling of kidneys and liver; enlargement of inguinal, cervical, axillary, bronchial and mesenteric lymph-nodes. Thymus greatly enlarged. Dimensions: Length, two inches; breadth, two and three-quarter inches; thickness three-quarters

of an inch. Microscopic examination: Simple hyperplasia of thymus.

Case 2. Boy, nine years old. Epidemic cerebro-spinal meningitis. Duration of illness, two days. Status lymphaticus. Thymus enlarged, extending almost to auriculo-ventricular groove. Spleen small. Lymphoid elements prominent. Peyer's patches and lymphoid follicles of intestine hyperplastic. Mesenteric lymph-nodes enlarged to size of almond. Hypertrophy of tonsillar ring.

Case 3. Boy, twelve years old. Ill four and one-half days. Epidemic cerebro-spinal meningitis. Status lymphaticus. No axillary or pubic hair, pubes being covered with lanugo. Thymus enlarged, extending half way down over pericardium. Marked hypertrophy of lingual, pharyngeal and faucial tonsils. Aorta is narrow.

Case 4. Male, aged eighteen years. Epidemic cerebro-spinal meningitis. Patient unconscious when admitted to Bellevue Hospital. Only five days in United States. Large well-developed subject. Lanugo on lips and face. Axillary hair scant. General rotundity of limbs. Thymus enlarged, reaching down to auricles of heart. Hypoplasia of aorta.

Case 5. Male, nineteen years old. Epidemic cerebro-spinal meningitis. Death on fourth day of illness. Status lymphaticus. Suppurative pericarditis. Thymus enlarged, extending downward to pericardium. Pulmonary valve has only two cusps. Retro-peritoneal glands enlarged. No lymphoid hyperplasia of spleen or intestinal tract.

Case 6. Female child, twelve years old. Epidemic cerebro-spinal meningitis; acute mastoiditis; acute parenchymatous nephritis. Status lymphaticus. Death on second day of illness. Thymus enlarged $12 \times 6 \times 1\frac{1}{2}$ cm. Weight thirty-one grams. Pubic hair developed. Axillary hair absent. Well-developed body. Inguinal, axillary and cervical nodes enlarged to size of almonds. Large adenoid. Hypertrophy of faucial tonsils. Aorta shows a dimple of the ductus arteriosus, with a prominent ridge above it, taking in half the circumference of the vessel, which is slightly stenosed. Both adrenals swollen and hemorrhagic, the right measuring $5 \times 3 \times 1$ cm. Uterus, 3 cm. long, of which 2 cm. belongs to cervix and 1 cm. to body.

Case 7. Female, twenty-eight years old. Epidemic cerebro-spinal meningitis. Status lymphaticus. Duration of illness twenty-four hours. Persistent thymus, glandular on section. Mesenteric

and retro-peritoneal glands hyperplastic, and as large as almonds. Superficial lymph-nodes and faucial tonsils enlarged.

Case 8. Male, eighteen years old. Pyemia. Death on eleventh day of illness. Status lymphaticus. Thymus enlarged, reaching to lower border of third rib. Staphylococcus isolated from blood during life. Multiple abscesses of lungs, suppurative myelitis. Poorly nourished subject; broad perineum. Small external genitals. Pubic hair female type. No axillary hair and none on chest. Bronchial lymph-nodes enlarged and suppurating. Peyer's patches and solitary follicles of small intestine are prominent. Mesenteric and retro-peritoneal glands enlarged.

Case 9. Woman, twenty-three years old. Exophthalmic goiter. Status lymphaticus. No history obtained. Thymus enlarged. Weight thirty grams, completely covers pericardium. Small woman, fairly well developed. Pubic hair well developed. Retro-peritoneal lymph-nodes contain tubercular foci. Lingual and faucial tonsils enlarged. Marked hypertrophy of lymphoid follicles of pharynx. Mesenteric lymph-nodes enlarged. Thyroid and parathyroids enlarged.

Case 10. Boy, five years old. Ill for one week; intubated on suspicion of diphtheric laryngitis. Autopsy, status lymphaticus. Larynx normal. Thymus enlarged, weighing thirty-three grams. Peripheral lymph-glands are enlarged to size of large peas or almonds. Hypertrophy of faucial and lingual tonsils. Mesenteric and bronchial glands enlarged, the latter being slightly pigmented. No note made of collapse of walls of trachea. This case resembles the type due to suffocation caused by mechanical compression of trachea by enlarged thymus gland.

PATHOLOGY OF STATUS LYMPHATICUS.

The gross lesions of status lymphaticus found after death consist, as already stated, of hyperplasia of the thymus gland and lymphatic elements throughout the body. The hyperplasia of the thymus is described by Ewing "as usually being a simple hyperplasia of the lymphoid cells, enlarging and multiplying the follicles sometimes causing the deposit of small nodules of lymphoid cells in the centers of the lobules, in the trabeculæ, or even in the outlying adipose tissue." With the general hyperplasia of the lymphoid elements Blumer found a proliferation of the endothelial cells lying along the trabeculæ of the organ. The thymus is occasionally fatty.

The hyperplasia of the lymphatic system is shown by enlargement of the cervical, axillary, inguinal, mesenteric and bronchial lymph-glands, by hyperplasia of the faucial, pharyngeal and lingual tonsils. The solitary and agminated lymph-follicles in the intestinal tract are often hyperplastic, and there is generally present an enlargement of the spleen, due to a similar simple hyperplasia of the lymphoid elements, accompanied by hyperemia. On cross-section the enlarged malpighian bodies of the spleen stand out prominently from the surrounding pulp. There is occasionally an infiltration of the splenic pulp by the lymphoid cells. Ewing has observed a hyperplasia of the lymphoid marrow of the long bones and McCardie an enlargement of the tongue, in addition to the hypertrophy of the lingual tonsil. I am inclined to think this observation of McCardie an accidental finding, due to some other cause than status lymphaticus. Paltauf noted a lessening in the amount of hemoglobin in the blood, while Ewing in one instance observed a lymphocytosis of seventy-six per cent.

Anomalies of the heart and arteries are frequently present. Case 2 presented a pulmonary valve with but two cusps, while cases 3 and 6 showed hypoplasia of the aorta. This latter lesion produces a small pulse which may be detected clinically.

Anomalies of the thyroid gland are often found in people dying from status lymphaticus. Wynne, quoted by McCardie, reports a series of twenty cases, in all of which the thyroid was abnormal. In ten it was markedly enlarged. In the others it was of normal size, or but slightly enlarged. Microscopic examination showed marked changes in all twenty cases, either reduction or absence of the colloid material, with hyperplasia of the cells which grow into the alveoli. Warthin observed hyperplasia of the parathyroids in one case of status lymphaticus, associated with acromegalia. Among associated conditions, exophthalmic goiter probably ranks first in importance. Capelle, quoted by Hart, states: 1. Among 19 Basedow patients who died of intercurrent diseases, 14 were thymus carriers, i. e., 44 per cent; 2. Among 17 patients who died from Basedow's disease, 14 were thymus carriers, i. e., 82 per cent.

Other associated conditions are idiopathic epilepsy, acromegalia, myxedema, rickets and Addison's disease. Hedinger states that in a strikingly large number of cases he found Addison's disease in combination with status lymphaticus.

From a study of the cases already quoted, we see that status lymphaticus is a frequent cause of sudden death during anesthesia, infectious disease, and from trivial shock, such as bathing, etc. In

the cases of meningitis reported by the writer, death occurred early in the disease, distinctly modifying its course. Daut, quoted by Blumer, states that in a series of patients dying from diphtheria, over 25 per cent had status lymphaticus. He says that "distinct modifications of the clinical picture of the disease (diphtheria) were present in these cases. In some instances the patients had a hoarse barking cough, and a hoarse voice, associated with attacks of spasmodic suffocation, weakness of the heart and rapidity of the pulse. These attacks were altogether out of proportion to the severity of the membrane formation as shown post-mortem. In other cases the patients died suddenly, having shown no unusual symptoms during life referable to status lymphaticus."

THEORIES OF DEATH: There are three theories advanced to account for sudden death in status lymphaticus: 1. Theory of mechanical compression; 2. Paltauf's theory; 3. Theory of hyperthymization.

1. Compression Theory. It has been proven that in rare instances the enlarged thymus gland may compress the trachea sufficiently to cause death by suffocation. The relief afforded by thy-mectomy is proof of this fact. In this connection the thickness of the thymus is of more importance than its other dimensions, as the following figures of von Sury show:

Average thickness of thymus	Average sterno-vertebral distance
Newly-born	1.1 cm. 1.6 cm.
Child in 1 month	1.4 cm. 1.7 cm.
Child in 2-9 months	1.5 cm. 2.0 cm.

Thus we see that at the superior aperture of the thorax there is normally only a space of one-half cm. between thymus and the bony walls of the chest, measuring from before backward. Forcible extension of the head decreases this distance. In rickets this sterno-vertebral distance is apt to be small, owing to the frequent occurrence of lordosis.

2. Paltauf's Theory. Paltauf believes that the hyperplasia of the thymus and lymphatic apparatus is due to an intoxication of the organism caused by faulty tissue changes, or by such common causes as infection and hereditary syphilis. The nerve centers governing the movements of the heart become affected, and a lessened resistance of the individual toward harmful external influences is induced. Under such circumstances the heart may suddenly become incapable of functioning.

3. Theory of Hyperthymization. There is thought to be a pathological increase of the internal secretion of the hyperplastic

thymus, which renders the organism more susceptible to external influences. According to Hart, Barbarossa states that thymectomized animals are capable of offering considerable resistance to chloroform poisoning, while animals and men with persistent thymus glands succumb to small amounts of this drug. Further, the theory of hyperthymization is substantiated by the findings in Basedow's disease. Wiesel holds that the hypoplasia of the chromaffin system found in status lymphaticus is responsible for a diminution in the tonicity of the vessel walls and cardiac muscle. Thus sudden death from arterial and cardiac atony and dilatation may occur.

MODE OF DEATH. In the cases of death during anesthesia collected by McCardie, that observer reports that death always occurred suddenly. "In certain cases facial pallor and dilated pupils were first noticed, and then it was found that cardiac action had stopped. In others respiration was observed to become superficial and intermittent, and at the same time the pulse was impalpable; in yet others cyanosis first appeared together with dyspnea, the circulation quickly failing afterwards. In another type of case there was a sudden failure of circulation and respiration, apparently simultaneously." The heart and right ventricle were usually found dilated. The ages of the cases in McCardie's series varied from six months to fifty-five years.

DIAGNOSIS OF STATUS LYMPHATICUS. It is a deplorable fact that none of the cases of status lymphaticus dying under anesthesia have been diagnosticated before autopsy; yet the diagnosis can undoubtedly be made if the condition is borne in mind, and the patient properly examined. Status lymphaticus should be suspected in an individual who gives a history of one or more sudden unexplained deaths in other members of his family. Hedinger reported the sudden deaths of five children in one family, before they reached the age of six. Autopsy on one of them showed a large thymus and status lymphaticus.

Individuals with status lymphaticus often have a pasty skin, a large amount of subcutaneous fat, and may show evidences of old or recent rickets (Conner). There is a general rotundity of the limbs, which is very characteristic, and which was noted in case 4 of this series. Adults often show an absence or scanty condition of the axillary and pubic hairs, which, together with the hair of the head, may have a peculiar dry, brittle character. In adults signs of infantilism may be present, characterized by small external genitals or an infantile uterus. There is generally an enlargement

of the external lymphatic glands, axillary, cervical and inguinal, accompanied by hyperplasia of the faucial, pharyngeal and lingual tonsils. The spleen may also be enlarged and palpable.

McCardie states that "signs of low blood-pressure may be associated, e. g., pupils comparatively large, a low tension pulse, heart sounds thin and flabby, giving one the idea of thin-walled, dilated cavities and of small muscular power." If the blood-pressure is low, it can be detected by the sphygmomanometer. A finding of a lymphocytosis or diminution of the hemoglobin of the blood would aid in the diagnosis. Inspection of the chest may possibly show a pulsating tumor above the sternum, when the thymus is greatly enlarged, or this tumor may be palpated by the finger of the examiner.

PERCUSSION. Light percussion with the finger should be employed. Warthin says: "The area of thymic dullness is triangular, with unequal sides, the base at the level of the sterno-clavicular articulations, and the blunt apex is behind the second intercostal space or the upper part of the third rib. The side boundaries extend somewhat beyond the sternal lines, usually more to the left than to the right. An area of dullness extending more than one centimeter beyond the sternal lines may be taken as evidence of an enlarged thymus."

In a case of thymic asthma, during the attack, we have the picture of a child suffering from inspiratory dyspnea. The respiration is noisy and stridorous in character. There is retraction of the supra-clavicular and intercostal spaces. The child is very restless and perhaps cyanosed. No history of a diphtheritic infection is obtainable. Examination of the larynx is negative, but tracheal stenosis is demonstrable by a long tracheoscopic tube (Jackson).

The most certain and only reliable method of diagnosis is radiography. Warthin states "that the radiogram of the normal thorax of an infant shows in the median line a flask-shaped shadow having a narrow neck and plump body, the neck portion of the shadow reaching from the first or second dorsal vertebra to the fifth or sixth. The body of the flask corresponds to the cardiac shadow, while the neck shadow—the lateral boundaries of which only slightly exceed those of the vertebrae—is the shadow of the thymus and great vessels. Under pathological conditions, i. e., with hypertrophy of the thymus, the neck portion of the shadow broadens." Warthin has well shown this by radiograms.

RESUME. 1. The thymus gland is probably an epithelial organ with an internal secretion.

2. The diagnosis of status lymphaticus as a cause of death is made too frequently. Hammar's statistics show that the thymus gland is normally much larger than is generally supposed.
3. Mechanical tracheo-stenosis undoubtedly exists as a cause of death in rare instances.
4. The usual cause of death in status lymphaticus is probably a "hyperthymization" of the organism, which renders it peculiarly susceptible to harmful external influences, such as shock, anesthetics and infectious disease.
5. The diagnosis of status lymphaticus can undoubtedly be made *intra vitam*. The X-ray offers the most certain and reliable means of determining the presence or absence of an enlarged thymus gland.
6. If status lymphaticus exists, chloroform is the most dangerous anesthetic.

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SUPPURATIVE EAR DISEASE IN DIABETES MELLITIS.*

BY OTTO J. STEIN, M. D., CHICAGO.

I will first report to you three cases of suppurative otitis media complicating diabetes mellitus in order to illustrate several different phases of the subject under discussion.

Case 1. A young lady, N. O. D., 21 years of age, presented herself at the Post-Graduate Clinic with a history of suppurating ears for two years. Both middle ears showed considerable destruction. The greater part of the drum membranes was gone. No visible signs of the ossicles. The middle ear cavities and the auditory canals were filled with thick, fetid purulent secretion. The ears were very sensitive to the touch, the integumental canals swollen, the meati and ear lobes incrustated with the dried secretions of a severe eczema. This eczema extended even to the auricular fold back of the ears and to the neck just below.

In the presence of an eczema, it is good routine to look for the existence of glycosuria. On inquiry it was learned that she had polyuria, inordinate thirst for water, dry skin with itching, and eczema about the ears and abdomen, and that she suffered occasionally from boils. Examination of the urine revealed a large amount of sugar, but the exact percentage was not reported. Diacetic acid and acetone were positive, the latter being detected on the breath. She was advised as to the correction of her diet and hygiene. The suppurative ears and eczematous patches were treated, with the advice to prepare for a radical operation upon the ears, in order to lessen the danger of extension of the disease. She was very loath to any operative interference, but, nevertheless, she was repeatedly urged. Suddenly she ceased coming to the clinic. A few weeks later we learned that she developed an acute exacerbation in the left ear due, it was reported, to a "cold." The family physician referred her to a hospital near home. There she lay for seven days. The course of the disease during this time was typical of an infected sinus from a mastoid extension. The temperature at first ran from 104° to 105° F., was preceded by a pronounced chill and followed by profuse perspiration. There was severe pain over the left side of the head, face, neck and shoulder. A painful induration developed in the neck. There was some edema about

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the mastoid, severe nausea and considerable vomiting. After the first few days the temperature dropped and thereafter remitted, associated with chilliness and perspiration, nausea, vomiting and pain. The eyes were examined but disclosed nothing. The patient died with symptoms of general sepsis. No operation was performed and no autopsy obtained. Therefore, the exact conditions cannot be stated, but the clinical picture is clearly one of intracranial character in consequence of the otitic disease.

Case II. J. G., a Jew, 62 years of age, presented himself with a severe pain in the right ear, caused, he stated, by a "cold." He had been suffering for three weeks with earache with an intermittent discharge and a temperature of 100° F. No history of previous ear trouble. Has had diabetes for three years. Examination of ear was very painful. Patient complained of a pain radiating to the temple and top of the head. The mastoid region was exceedingly sensitive and slightly puffy. The ear canal was full of secretion, mucopurulent in character, but not particularly offensive. Examination showed this to be a mixed infection, both pneumococci and staphylococci predominating. On cleansing the canal the drum membrane appeared somewhat reddened and bulging, but no perforation could be seen, so I judged the leakage to be peripheral. External heat and warm phenoglycerine were used. Twenty-four hours later I incised the drum-membrane freely and this emitted a copious discharge of pus for several days with corresponding improvement in all the symptoms, although the pain about the mastoid region and side of the head was sufficient to bother the patient for some two weeks more. A slight discharge from the middle ear continued for another two weeks, when all discharge, pain and other symptoms disappeared entirely, leaving him free from any sign or symptom of ear disease. On examination the urine was found to contain 2 per cent sugar and diacetic acid and acetone; these were reduced by the regulation of his diet and hygiene.

One year later examination showed drum-membrane intact, ear free from pain and discharge since the attack, and only slight impairment of hearing and tinnitus in this ear. He is now passing one gallon of urine in the 24 hours, containing $1\frac{1}{2}$ per cent sugar and no diacetic acid or acetone.

Case III. A young woman, C. L., 34 years of age, referred for deafness and chronic discharge of years' standing, has been under continual treatment of local specialists for several years. Claims not to have been well for years, suffering from gastro-intestinal

trouble and a general nervousness. No family history of tuberculosis. Examination of her left ear showed it to be the seat of an old* suppurative process, although it was apparently dry at this time. A scar over the mastoid region showed the site of a healed fistula of former years. The drum-membrane revealed a large perforation anterosuperiorly through which a part of the head of the malleus was seen; the long process is apparently all present and attached in its usual position to the drum membrane. A large perforation in the posterior half of the drum is also present. Many adhesions in the middle ear are apparent. Hearing, two and one-half feet for whisper. Rinné, negative. Weber not defined. The tube was open. The patient has distinct recollection of pain in this ear as a child. The right ear on examination revealed a very large perforation into the attic, discharging a small amount of fetid pus. The patient claims to have no recollection of pain in this ear. The remaining part of the drum-membrane was very much thickened and rigid. No ossicles could be seen, but their presence could be demonstrated by a probe. Hearing, one foot for whisper. Rinné negative. Tube open.

At first I was inclined to suspect that the otitic condition was tubercular, although I was never able to demonstrate this. Microscopic examination of the secretion showed a mixed infection of staphylococci and diplococci.

In discussing the method of treatment proposed, the patient's entire interest seemed centered upon her ability to hear. She cared nothing about the repeated recurrences of suppuration, but all she wanted was to win back as much of her hearing as possible. A few months of the most painstaking treatment convinced me that operative measures should be undertaken to check the disease. In order to secure her consent I proposed doing a conservative mastoid operation, whereby I promised that the operation would not further impair her hearing, but, on the contrary, would probably improve it. It was then that the presence of diabetes was discovered. The daily average of urine amounted to about two hundred ounces; specified gravity 1035; sugar 5 per cent with diacetic acid and acetone present. A rigid diet and hygiene were observed and the character of the urine rapidly improved. One and a half months after this we succeeded in obtaining urine that was free from sugar, acetone and diacetic acid. Both mastoids were then operated upon after the method of Heath. Chloroform was the anesthetic used, and at no time caused any alarming symptoms.

Owing to the very thick and dense mastoids and consequently very deep antri, the time consumed in operating the two mastoids was three hours. Some dark necrotic spots were found near both antrums, each of which contained a dense pyogenic membrane, covered with thick, foul-smelling pus. A thorough exposure of the antrum was made on each side, with removal of the superio-posterior bony wall down to the tympanic ring. The Panse flap was employed. Primary healing ensued and on the tenth day she came to the office for treatment. Healing within the ears was as rapid as in the ordinary case. It is just a year since this case was operated upon. The right ear has remained dry, the left has been wet on two or three occasions of short duration, and each time the urine examination showed either a trace of sugar or acetone or both. The hearing is materially improved in both ears.

In the first case cited every effort was made from the beginning toward directing the diabetes into a less active state in order to lessen the liability to serious destructive changes within the ear. Besides, in order to operate with the greatest degree of success the tissues should be placed in the most favorable condition for repair. The tardiness in gaining consent to an operation and a return to the active state of the diabetes with progressive and destructive changes in the temporal bone resulted in a fatal outcome.

In the second we have a recovery following an acute suppurative otitis media with mastoiditis in a diabetic of some years. It is worthy of note to observe that this patient is a Jew, of a race said to be susceptible to diabetes; that he was 62 years of age, when resistance, ordinarily, is considered less pronounced; that the ear trouble made its appearance in the presence of a diabetes of three years' standing, and finally that complete recovery ensued in the face of these ordinary hindrances and without further operative measure, aside from a free incision of the drum-membrane. Early recognition of the diabetes, free and early myringotomy and a careful diet and hygiene in the presence of an inactive diabetes, I assume to be the reasons why this case terminated so successfully.

In the third case, judging from the history alone, I believe the ear trouble existed since childhood and that the diabetes is of about twelve years' standing, although not recognized at the time she had so much gastro-intestinal trouble. That there is an inactive state in diabetes seems plausible, as this patient was suffering from a destructive suppurative process in both middle ears covering a period of many years, producing no alarming ear symptoms and not

enough general symptoms to cause the diabetes to be recognized for a long time. Besides the osteosclerosis of the mastoid process found present at the operation indicated good repair on the part of the tissues.

The history of these cases emphasizes the importance of recognizing the presence of existing systemic affections. In quiescent cases of diabetes the clinical symptoms of the disease may easily pass unrecognized. In doubtful or suspected cases, the blood and urine should be examined. One must not be misled by an apparent negative finding. Sugar may be present in one specimen and not in another, or only acetone or diacetic acid may be demonstrated. Every case of glycosuria does not of necessity mean diabetes, because sugar may appear in the urine transiently from the anesthetic, shock, or an excessive sugar or starch diet. Neither does every case of polyuria in itself mean diabetes. Diabetes mellitus is essentially a disorder of metabolism, the cause of which is believed by the larger number of observers to be due to an inhibition of the glycolytic function of the pancreas, supplemented by a perverted fat oxidation. The metabolic results of such processes are different, but can alike be found in the urine. In the first instance it is assumed that those cells of the pancreas known as the Island of Langerhans secrete a ferment essential to the conversion of the glucose, ingested as carbohydrates, into glycogen, whence it is then oxidized in the tissues and utilized as heat and energy. A failure of the glycolytic function of the pancreas, commonly the result of a fibrosis, creates the condition of hyperglycemia and glycosuria. Where power to oxidize the fat of the ingested food is lowered, there is caused to appear in the urine oxybutyric acid and its derivatives, diacetic acid and acetone. These two processes, the inhibited glycolytic action of the pancreas and the suboxidation of the fats, net a morbidity of sugar, oxybutyric acid, diacetic acid and acetone in the blood and urine, the continuance of which leads to various nutritive changes in the tissues. Certain catabolic processes may result in which the body proteids are destroyed creating an excretion or excess of nitrogenous matter such as urea. A predisposition to various endogenous processes is created until there results retention and absorption of toxins, a factor probably leading to such arterial changes as arteriosclerosis and thrombosis. The sugar in the tissue is particularly favorable to the development of microorganisms. What influence these now generally accepted changes of metabolism have upon the organ of hearing remains as yet to be clearly set forth. The present literature on otitic mani-

festations in this disease is astonishingly barren. This cannot be on account of a scarcity of such association of disorders, because the contrary is true. Both the disease diabetes and its concomitant otitic affection are far from uncommon, but the failure to trace the association of the two is rather frequent. I do not question for a moment that, if we picked out the various clinical symptoms present in a large number of these cases, such as pharyngitis, sicca, boils, eczema and polyuria and welded these various rings together, we would soon have a chain that would spell diabetes mellitus, which is then easily proven by the blood and urine analysis. I have been astonished to find, since I have taken up the more careful observation of the association of these two disorders, how frequent they are. Suppurative ear disease in the presence of diabetes is always a serious complication, but not necessarily an alarming one. When the diabetes makes its appearance during the existence of a chronic suppurative disease, the ear affection is not as likely to be alarming as when the ear affection makes its appearance in the presence of the diabetes, particularly where an active diabetes has not been recognized or is not under treatment. These conditions have a bearing upon the severity of the suppurative process and at the same time have a bearing upon the results obtained from treatment. In active diabetes there is present a lowered tissue resistance inviting chronic degenerative processes in which there develops a variety of conditions like cataract, arteriosclerosis, loss of hair and teeth, atrophy, and in bone and in the skin particularly is noticed a susceptibility to traumatism, a tendency to delayed healing and an inclination to acute infection. The degree of diminished resistance depends upon the activity of the disordered metabolism, for it is readily noticed that, when the hyperglycemia and hyperacidity are reduced, there is a corresponding improvement in the degenerative process, that is, wounds heal, skin diseases disappear, vision improves, the body takes on weight and a more youthful appearance, the teeth become firmer, the hair comes in, etc.

Owing to the absence of sufficient pathologic evidence the question as to a pathological entity ascribed to diabetic otitis media and mastoiditis still remains debatable. It has been credited to Kuhn and later to Kerner and concurred in by MacCuen Smith that primary mastoiditis in diabetes is a fact, but Eulenstein in an analysis of almost seventy cases fails to find sufficient corroborative evidence to warrant the foundation of a special pathology in these cases. The mucous surfaces are prone to congestion, presumably

due to the elimination of toxins. The mucous membrane of the nose, throat and ear is conspicuous in such manifestations, and as a consequence of the hyperemia there may follow hypersecretion, altered secretion, infection, dryness, ulceration, and necrosis. The mucous membrane of the Eustachian tube, cavum tympanum, mastoid antrum and cells, when affected by this congestion secretes an excess of mucus that is highly susceptible to bacterial contamination, which consequently means a mucopurulent and also a sanguinolent product. Besides the mucous membrane congestion there is a tendency to hemorrhage and extravasation in the sub-mucosa and deeper tissues. Serous effusions and hemorrhage in the drum-membrane may occur similar to what is seen in Bright's disease; this may produce some pain, but it is of short duration. The acuity of hearing being mainly blunted is the symptom complained of. A bleb of varying size, usually that of a millet seed, and of a dusky purple hue, is made out. If it has ruptured, it may be mistaken for a perforated drum-membrane of acute middle-ear origin.

In that variety of otitis media which appears suddenly and without any apparent cause, it is well to investigate as to the presence of a diabetes. It has been my observation that in such cases little or no pain precedes a spontaneous rupture of the drum-membrane followed by profuse discharge. The mastoid seems to be almost inevitably involved. Bar, to the contrary, mentions that the pain is severe and not relieved by perforation of the drum, and that the discharge is persistent with a tendency to sanguinolency. This bloody discharge, I also have noticed. Kuhn, one of the earliest writers on this disease, speaks of the frequent occurrence of middle-ear suppuration in diabetes, and says that the discharge is profusely purulent with a tendency to a sanguinolent character, and that the mastoid becomes extensively involved, as well as rapid involvement of the labyrinth. Bonninghouse, speaking of the bone complications of acute otitis media, says that in people of feeble resistance and in the old, diabetes produces in a very short time extensive disintegration of the mastoid process, the first blow of the chisel through a brownish discolored cortex exposes a large, granulating cavity involving the entire process from tip to antrum and even to the inner table. Kuhn, in his article, "*Erkrankungen des Ohres bei Diabetes Mellitus*," emphasizes the important fact of the tendency to rapid extensive involvement of adjacent parts of the middle ear, like the mastoid and labyrinth. Both ears may be

come simultaneously involved. He refers to three cases of sigmoid sinus phlebitis, belonging to Scheibe, Kirchner and Frerichs, and one case of meningitis, belonging to Scheibe complicating diabetes. In a case of Moss, the streptococcus pyogenes and Fränkels diplococcus were found, and in a case of Kuhn's, the streptococcus pyogenes and staphylococcus albus were found. Suppuration of the labyrinth is usually secondary to the middle ear process and is not uncommon in the presence of a diabetes. Friedrich in his monograph, "Die Eiterung des Ohrlabyrinths," concludes that one suppurative labyrinthitis results in every one hundred cases of suppurative otitis media, while Bezold places diabetes mellitus as second in the list of chronic systemic causes of suppurative labyrinthitis.

One infers from these statements that suppurative panotitis is a condition that should always be looked for and anticipated in the diabetic, and therefore, watchfulness in discovering the diabetes, enforcing a carefully-arranged mode of living and diet, will frequently aid in placing the patient in what may be termed a non-active state of his diabetes, at which time the suppurating ear may be operated upon with a greater certainty of recovery. The amount of sugar or acetone cannot solely be depended upon as an index of the activity of the disease. Neither can the prognosis after operation be established from this evidence alone. Some few may recover with a large per cent of sugar present and a few cases have been observed where the patient died and no sugar was present. The young diabetic does not withstand the disease very well and more frequently dies early and in coma. In the active state of the disease, even though it be under treatment, there exists in some cases a hypersusceptibility to any operative interference, even of the most minor character. Some of them have been known to pass into coma and die within a few hours after a simple incision. But as a general rule the inactivity of the diabetes, a minimum of sugar and acetone, middle age or past, rapid operation and a minimum of anesthetic are conditions that favor healing and recovery in the suppurative ear diseases of diabetes.

SEVERE SEPSIS FOLLOWING TONSIL OPERATIONS*

**With A Case of Death from Sepsis Following Tonsillectomy;
A Case of Cerebral Thrombo-Sinusitis Following Tonsillotomy;
A Case of Gangrene of Muscles of the Neck Following Tonsillectomy.**

BY L. W. DEAN, M. D., IOWA CITY, IOWA.

The frequency of infection following tonsil operation I have been unable to determine. A careful examination of the literature has failed to furnish me with any substantial material upon which to base such an opinion. Some operators have been specially fortunate in this line while others have not been so fortunate. Waugh¹ reports nine hundred cases of tonsillotomy without any complications, hemorrhage or sepsis. He examined the cases at the end of the first and fifth week. Mackenzie² reports two hundred and thirty cases of tonsillotomy with no case of sepsis following. Casselberry³ in treating of the indications for surgical interference in diseases of faucial tonsils and the methods of choice in operating gives an analysis of four hundred and eighty cases of tonsil operations, most of them double. He does not mention a case of infection. L. C. Deane⁴ states that in his large experience in tonsil surgery he had only two cases that were followed by systemic infection.

The review of the literature shows that many others have not been so fortunate. In my experience sepsis has been a more formidable sequela of tonsil operations than hemorrhage. I am more afraid of it. Mild infections accompanied by cervical adenitis and sometimes high fever and infections of the ear and other neighboring structures have not been uncommon in my practice. I have had two cases of exceedingly severe infection. The report of these will appear later in this paper. These infections are not due to lack of proper precautions because my cases are almost always prepared by local and general treatment and the most careful asepsis practiced during the operation. Usually the tonsil crypts are disinfected for several days before the operation and a laxative is given the night before. Most of the operations are performed in

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the hospital under aseptic conditions. After the operation a hydrogen peroxide gargle is used frequently, and twice a day the tonsil wounds are carefully cleaned with hydrogen peroxide, care being taken not to injure the cut surfaces. All patients remain in the hospital from five to ten days. I keep my patients quiet in the hospital because I believe that, first, this is a good way to help prevent hemorrhage, and, second, because chilling of the body, overexertion and other indiscretions by reducing the resistance of the tissues are very pregnant causes in the production of sepsis.

When we consider the bacteriological flora of the mouth and the impossibility of disinfecting it, it seems marvelous that there is not more infection following an operation that leaves the cut veins exposed and lymphatics open.

In my experience the infections have been much more frequent and severe since I have been performing tonsillectomy and not tonsillotomy. Of my two very severe cases one followed tonsillotomy, the other tonsillectomy. I regret very much that I cannot find sufficient literature upon this subject to warrant a positive opinion. The danger of infection following enucleation of tonsils is my main reason for not enucleating tonsils, unless badly diseased, in children too young to have the throat properly prepared before the operation and treated after. In babies, where it has seemed best to enucleate tonsils I have had no infection of any importance.

I have avoided doing tonsil operations if an acute inflammation of the throat is present or if the patient's temperature is not normal, unless the fever be due to some process which cannot soon be remedied, as tuberculosis. Neither do I operate immediately following an attack of acute tonsillitis. One of the most severe cases of infection following a tonsil operation that has been under my care was the result of tonsillectomy done during an attack of acute tonsillitis. Eight years ago a patient came to me to have his tonsils trimmed. He had acute tonsillitis. I told him he must wait until the throat was normal. The same day a general surgeon performed a tonsillotomy. I saw him on the second day. He had a very bad double-sided cervical adenitis, with a temperature of one hundred and four. An abscess formed on one side of the neck. It was four weeks before he left the hospital.

A few express an opinion that the presence of acute inflammation of the tonsil is not a contraindication for tonsil operation at the time. Behrens⁵ submits a report of one hundred and twenty-seven tonsillotomies, some in the acute stage of diphtheritic infection.

There is no mention of any systemic infection in this series. Bleasdale⁶ reports two cases of acute tonsillitis where he removed one tonsil with a guillotine during the attack without any complications. He thinks that an acute tonsillitis is no contraindication to the removal of a tonsil. Ricordeau⁷ in 1886, in describing accidents following tonsillotomy called attention to mild infections with much edema following tonsillotomy that might prove fatal. He called attention to subacute inflammation of the remnants of the tonsil, its spread to other parts of the pharynx and glottis and sudden death that may result from it. He quotes Bauchacourt⁸ as reporting a case of this kind where the patient died of edema of the glottis, and Martin,⁹ who published two similar cases. The author cites two cases of his own of tonsillotomy followed by edema of the throat with a fatal issue in one.

Case 1. A woman aged thirty-six; tonsillotomy followed by edema of the throat with disturbed respiration and difficult deglutition. Recovery.

Case 2. A male aged twenty-five to thirty. Tonsillotomy. Edema of the throat eleven hours later. Death that same night. Autopsy showed nothing outside of intumescence and infiltration of cellular tissue of the larynx and pharynx.

Le Play¹⁰ reports a case of infection following tonsillotomy that was accompanied by a scarlatiniform eruption. Fisher¹¹ reports two cases of postoperation rash after tonsillotomy:

Case 1. Male, aged seven years; developed a scarlatiniform rash after tonsillotomy. The cervical glands were enlarged and the tonsils and pharynx were covered with necrotic patches, resembling scarlet fever. The temperature rose to one hundred and five degrees. Vomiting preceded the rash. Toxemic symptoms were present. In the second week acute nephritis and double otitis developed. The temperature persisted five days after the opening in the middle ear was enlarged so that the toxemia of the nephritis evidently caused the febrile disturbance. There was no previous exposure to scarlet fever.

Case 2. Female, aged three years. The removal of tonsils and adenoids was followed by an eruption of three days' duration. The temperature was one hundred and three degrees. The cervical glands were swollen. The tonsils and pharynx showed evidence of necrotic patches. Desquamation. Recovery at the end of two weeks. Diagnosis, postoperative scarlatiniform eruption. The author is of the opinion that the infection took place before the opera-

tion, that the trauma lowered the resistance and shortened the period of incubation. He expressed the opinion that if the child's temperature is above normal the operation should be postponed.

Wingrave¹² reports thirty-four cases of surgical rash after tonsillotomy in the course of seven years. The constitutional disturbance was slight. L. C. Deane,¹³ reports a case of tonsillotomy in a patient nine years old that was followed on the fourth day by a rash on the body, general malaise, loss of appetite and a temperature of 101.6°. The rash was on the inner side of both thighs; an erythematous rash covered the fact. Lichtwitz¹⁴ claims to have found Loeffler's bacilli in eleven out of twenty-seven cases, or 40 per cent of tonsillotomy by electrothermic cautery in the pseudomembrane covering the operative wound. The clinical course of these cases did not differ in any way from the cases in which the Loeffler bacilli were not demonstrated. The Loeffler bacilli, even when associated with streptococci in these cases, have no effect on the clinical course. Harmer¹⁵ made a series of experiments with a view of verifying the findings of Lichtwitz. Nine of the guinea pigs he inoculated died. He found no Loeffler bacilli, but found pseudodiphtheria bacilli in eight out of thirty-one cases or 25.8 per cent after tonsillotomy with sharp instruments. Kobiak¹⁶ reports a case of diphtheria infection in a child after removal of the tonsils and adenoids. There was both throat and nose infection and an abscess of the posterior pharyngeal wall. He expressed the opinion that she carried the diphtheria bacilli in her throat, which became virulent after the operation.

Caille²⁰ reports a case of tonsillotomy followed by diphtheria and croup. A boy, four years of age, with hypertrophic tonsils, adenoids, swollen gums and carious teeth, was operated on at once, without preparatory prophylactic treatment, contrary to the author's usual custom. A tonsillotomy was performed. The next day the boy was violently sick. The stumps of both tonsils were covered with a dense pseudomembrane, extending over a portion of the anterior arch of the soft palate. The entire pharynx was intensely hyperemic; bilateral submaxillary glandular swelling was pronounced and high temperature and general prostration were present, together with other troublesome symptoms, such as vomiting and cerebral unrest. A swab culture from the pseudomembrane and one from the carious teeth and gums revealed bacilli and streptococci. The following day croupy cough and stenotic breathing. Twelve hours later the posterior surface of the epiglottis was found

covered with a thin deposit and the laryngeal stenosis had increased. On the following morning intubation was performed for dangerous stenosis. This is a unique case in the author's experience which he ascribes to lack of prophylaxis before the operation.

LePlay²¹ reports the following case: Male, aged eight years, entered the hospital with a diphtheric angina and anti-diphtheritic serum was administered. There was bilateral cervical gland enlargement. Culture from the throat showed no diphtheria bacilli. It was learned that eight days previous a double tonsillotomy was performed. In the left lung distinct dullness with an expiratory egophonic souffle. An exploratory puncture at the lower angle of the patellus drew pus, containing on direct and cultural examination pneumococci. A pleurotomy was performed and drainage instituted. Recovery was complete in one month. The author mentions several points of interest. The traumatic origin of the false membrane on the tonsils lead to an erroneous diagnosis of diphtheria. The debility caused leads to infection by the bacteria in the mouth through the lymphatics of the mediastinal glands with general infection.

Ard²² in an article on the dangers associated with removal of the tonsils states that acute articular rheumatism and endocarditis have been reported as following tonsil operations. He quotes Hemmehert as reporting five cases under his own observation where septic infection of the serous membranes resulted. Severe inflammation of the cervical glands giving rise to severe and persistent symptoms was observed by Gronbeck in four cases. He reports Putnam as having seen two cases of meningitis follow the operation. He says middle-ear inflammation with mastoiditis has frequently developed after tonsil operations.

Paity²³ reports a case of acute mastoiditis with lateral sinus suppurations and cerebellar abscess as complications of the operation for the removal of tonsils.

C. C. Deane²⁴ reports the following case of infection following tonsillotomy. Two days after the operation there was pain and swelling in both wrists and the right ankle. On the fourth day there was pain in the precordial region. There was a murmur over the apex, with irregular and rapid heart action. There was no history of measles, scarlet fever, diphtheria or rheumatism.

Huber²⁵ reports the following case. Lateral pharyngeal abscess following tonsillotomy. Female, aged two years. Had postcervical adenitis when eight months old. The abscess was opened and it

healed in a short time, leaving a small scar. Tonsillotomy was performed for enlarged tonsils, and usual antiseptic after-treatment was carried out. A few day later torticollis considerable thickening of the tissues in the pharynx, laterally and to the right; subsequently suppuration occurred, with difficulty in deglutition. The lateral pharyngeal abscess was opened and this diminished. The torticollis persisted. Marked tenderness and swelling at the sight of the old scar in the postcervical region was present, later fluctuation. This was opened. Complete healing took place in two weeks.

Wishart²⁶ reports a case of hyperpyrexia and death after tonsillectomy. Autopsy showed a very extensive intestinal tuberculosis, acute nephritis, empyema of lungs and acute hepatitis. Death was evidently due to a virulent toxemia. Death came nineteen hours after the operation. The temperature reached 107°.

Ballenger²⁷ mentions two very severe cases of streptococcus infection in about nine thousand cases.

Pierce²⁸ reports a severe case of infection resulting in permanent torticollis following a tonsillectomy, with injury to the pharyngeal muscle.

Case I. The first case I have to report is one where death was due to infection following tonsillectomy. This occurred in the practice of L. L. Smead of Newton, Iowa, to whom I am indebted for the following history: Miss B., school teacher, aged twenty-seven years, of German descent. Was apparently well nourished but anemic in appearance. Family history: Father died from septicemia following an injury. One sister with hematuria; cause unknown. Mother living and well. Personal history: Patient had always had trouble with her throat. She was subject to attacks of headache, indigestion and the "blues." At times menstruation was painful and scanty. Present history: For four months preceding the operation did not feel well. Patient was anemic. One month before the operation suffered from follicular tonsillitis and some adenitis on right side of neck; there was also some enlargement of glands in the axilla. With the usual treatment for tonsillitis the inflammation subsided and treatment was instituted to overcome the anemia and improve her general condition. The glands became normal and her general condition was much improved. Her tonsils were large. She had difficulty in talking to her pupils. At night there was some obstruction to breathing. She was conscious of the act of swallowing. Tonsillotomy was advised. Examination of the urine was negative.

Operation: All instruments were boiled. The throat was cleansed by antiseptic sprays and gargles. Under local anesthesia the right tonsil was enucleated and the major portion of the left was removed. Because of hemorrhage the whole of the left tonsil was not removed. Patient bled very profusely and was weak from the operation and loss of blood. The morning following the operation the throat and adjacent structures were swollen and reddened, with fibrinous exudate covering the cut surface. The glands of the neck were somewhat enlarged and there was great pain in swallowing. Pulse was 110. In the evening the temperature was 102°. On the following days the temperature ranged from 101° to 103°. The throat and glands became greatly swollen. The fibrinous exudate did not change in size. On the third day there was great difficulty in swallowing and breathing. Patient was delirious when asleep. Vision was dim. There was moderate vomiting. The submaxillary glands were enlarged. On the fifth day the quantity of urine passed was diminished. Vision was still dim. Delirium was more pronounced. Some pus and some bloody sputum was expectorated. On the sixth day all the lymphatic glands of the body were enlarged. Only a very little urine was passed. Delirium was more pronounced. Patient died in a convulsion during the afternoon. A post-mortem examination was not made.

Case II. In May, 1905, the patient, a male, aged about thirteen years, presented himself at my clinic. Family history was negative. Personal history: He had had the ordinary diseases of childhood. A good history could not be obtained. He had suffered from occasional attacks of tonsillitis, but had had no attack for several months. Present condition: Tonsils enlarged. No cervical adenitis. General health apparently excellent.

Operation: Tonsillotomy with a tonsillotome was performed under local anesthesia. The patient was ordered to remain in the hospital for several days. The next day he left the hospital without notice. Up to this time he had had no trouble. Seven days after the operation I saw him again. Four days before I saw him, that is, three days after the operation, he had ridden on his bicycle a distance of eight miles and back. It was a very hot day. That evening he did not feel well. The next day he had very severe fever. Dr. C. B. Kimball of West Liberty, saw the patient. He found the boy very ill and advised that I be sent for, as the trouble was evidently connected with the recent operation. Two days later I saw the patient and found the following condition:

The remains of the tonsils were somewhat swollen and reddened. The cut surfaces were covered with a fibrous exudate. The pharynx was also inflamed. The condition of the throat was not bad. The temperature was 105°. It had been intermittent. There had been a series of chills. Pulse was 160, very weak. Patient was delirious. Along the anterior border of the sternocleido mastoid muscle a cord-like swelling could be very easily felt. This is the only case of sinus phlebitis where I have ever been able to detect this. On the left side was exophthalmos with panophthalmitis. On the right side was a well-marked optic neuritis. The ear and mastoid seemed normal. Dr. Kimabll's physical examination was negative. A diagnosis of septic phlebitis involving the internal jugular and extending along the cerebral sinuses to the orbital veins, accompanied by thrombosis of the orbital veins on the left and perhaps of the left cavernous sinus. A very bad prognosis was made.

The relations of the boy were rather peculiar people. They were wealthy but decidedly obstinate. Under the circumstances it seemed best to place a nurse in charge and do the best possible thing for the boy. Water in large amounts and whiskey were given by stomach and normal salt by rectum. No doctor saw the case after I was there. Daily reports by telephone showed an improvement in five days and in six weeks the boy was apparently well. I did not see him again but was told by his relatives that the stump of his left eye had been enucleated and he had fair vision only in the right. This case presents two very interesting points:

First, the extensive septic phlebitis with thrombosis. The phlebitis evidently extended along the palatine vein to the internal jugular, thence to the bulb, then either by the transverse and superior petrosal or by the inferior petrosal to the cavernous sinus and thence to the orbital vein and ophthalmic veins.

Second, the recovery from such an extensive severe condition. The age of the patient must have been quite an important factor in overcoming such an infection.

A similar case following phlegmonous tonsillitis has been reported by Seggel.²⁰ A robust soldier, aged twenty, developed an intense exophthalmos of the right eye with headache, chills, vomiting and intermittent fever, together with a violent phlegm of the right tonsil. Almost simultaneously blindness and immobility of the pupil of the right eye set in, soon followed by the same symptoms in the left without exophthalmos. Two days after the

exophthalmos the right internal jugular was felt as a hard cord. Under mercurial inunctions the patient recovered within two and a half months with atrophy of both optic nerves, total amaurosis of the right eye and preservation of a sector in the upper nasal quadrant of the left eye. The diagnosis was thrombosis of the orbital veins with or without thrombosis of the cavernous sinus.

Case III. Male, aged five years, came under my care November 1, 1908. Was well nourished, very robust and apparently in perfect health. Family history: Both parents alive and in good health. There was also one brother in good health. Personal history: In August, preceding the operation, he had had whooping cough from which he had apparently entirely recovered. He never had any other diseases of importance. Tonsils were large and diseased. There was no cervical adenitis. Physical examination was negative. Urine examination negative.

On November 29, 1908, tonsillectomy was performed. For one week preceding the operation the crypts of the tonsils were carefully cleansed and disinfected, and disinfectant gargles were used. The night before the operation a laxative was administered. The morning of the operation he entered the hospital and in the afternoon was operated. The most scrupulous care was used to see that everything was as aseptic as possible. A blunt-pointed knife and snare were used to remove the tonsils. The tonsils were examined after removal. There was no pharyngeal muscle-tissue adherent to them. The usual characteristics of chronically inflamed tonsils were observed. The patient remained in the hospital for eight days and then returned home. During this time his temperature was not above one hundred. He had no cervical adenitis or any trouble of importance. During this time a gargle of hydrogen peroxide one-third and water two-thirds was used. The tonsil wounds were not cleansed in our usual way, using hydrogen peroxide applied with cotton on a probe, because of strenuous objection on the part of the patient.

After the patient left the hospital the use of the gargle was continued. Fifteen days after the operation the patient was brought to my office. The mother reported that the boy had been apparently well but on that day they noticed an enlarged gland on the right side of his neck. At the anterior border of the sternocleidomastoid opposite the angle of the jaw there was a single enlarged lymphatic gland. It seemed to be the size of a small hazel nut. Temperature was normal.

Calomel in small doses with ice packs locally were prescribed. Temperature was taken every three hours. For three days the condition remained about the same. Maximum daily temperature was 100°. The boy was playing and eating as usual. During this time the pharynx surrounding the tonsillar region was reddened. There were no white spots on or near the tonsillar wounds.

On the evening of the third day, December 17, the boy's throat began to swell externally and became very tender. He refused supper. At eight p. m. his temperature was 104°. This fell rapidly to 101°. I saw him at eight thirty. The neck was badly swollen so that the head could not be moved. The skin was stretched tight and was reddened. No enlarged glands could be detected.

Calomel was again administered, ice applied continually. During the night the fever was intermittent, ranging from 100° to 104°. Pulse 120 to 135. There were several chills. The next morning the boy was very ill and was sent to the hospital.

At one p. m., under general anesthesia the neck was operated upon. An incision five inches long was made anterior to the sternocleidomastoid and parallel to it. The muscles of the neck, both the sternocleidomastoid and the deep muscles were found dark red in color, much swollen and mushy in consistency—not elastic as usual. They seemed friable. All the tissues of the neck were badly swollen and inflamed. Only one enlarged gland was found. That was the one that was detected several days before. It was about the size of a small hazel nut and was not broken down. This was removed. An incision was made posterior to the sternocleidomastoid muscle. The whole territory was thoroughly explored and irrigated with bichloride solution. A drainage tube was inserted passing from in front of the sternocleidomastoid muscle under it and out the posterior wound. Moist bichloride packs were applied and irrigation through the drainage tube with bichloride twice a day. Alcohol rubs and water in large amounts was given by mouth and the patient kept quiet in bed. Tincture digitalis and quinine suppositories were given. Most careful nursing was used.

The condition of the neck was so entirely different from what I had found in other cases of infections of this region that I considered the case a very grave one. I immediately associated with me in the case Dr. Robert B. Prebble, of Chicago, Dr. W. L. Bierring and Dr. Van Epps, of Iowa City, and a few days later Dr. Wm. Jepson, of Sioux City and Dr. Grant of Iowa City.

The condition was entirely a local one. The spleen, liver and lungs seemed normal. Associated with it was an exceedingly severe toxemia. For twenty-four hours following the operation temperature per rectum 101.4° to 103.6° . Pulse 100 to 138. There was no discharge from the wound. On irrigating there was also no discharge.

After the first day the temperature gradually improved and on the third day reached 98.8° . On the second day the blood count was as follows: leukocytosis thirty-five thousand, polymorphonuclear leukocytes 90 per cent. On the fourth day the temperature rose gradually again to 103.1° and remained there. On the fifth day the temperature had not diminished. The blood count was as follows: leukocyte count twenty-five thousand polymorphonuclear 95 per cent. The patient was rapidly weakening and the polynuclear differential count was becoming serious and a second opening of the neck was decided upon. The muscles of the neck were exposed freely. Surrounding the drainage tube that had been in position was a dense white membrane. It was so firm as to prevent drainage. The deep cervical muscles presented the same appearance as at the first operation. There were numerous bright, greenish-looking areas resembling the green spots around shot punctures in ducks that have been dead several days in warm weather. These spots varied in size from a fifty-cent piece to a silver dollar. There was no necrosis; there was no pus. The glands lying upon the muscles and those in the neighborhood were not enlarged. There seemed to be no effort at all on the part of the organism to resist the infection. Dr. Jepson, in his very extensive surgical practice had never seen anything like it. All who were present agreed that it was a very bad infection still local with gangrene of the muscles and but little effort was being made by the organism to overcome it. Because of the latter a bad prognosis was made. Following this operation the same treatment was carried out as before it, except the drainage tube was removed daily and a fresh one inserted. Following this operation the temperature rose and remained high for twenty-four hours, when it gradually began to fall.

On the fourth day after this operation the temperature rose to 104.6° , pulse to 150. Frequently the radial pulse could not be detected. The patient was emaciated and exceedingly weak. The bowels had been kept cleansed and normal salt enemata were frequently given.

The patient's condition was critical. It was evident he could not stand another anesthesia. As a last resort I again opened the neck widely and rubbed and washed the superficial and deep muscles with bichloride, left the wounds open and packed bichloride dress-

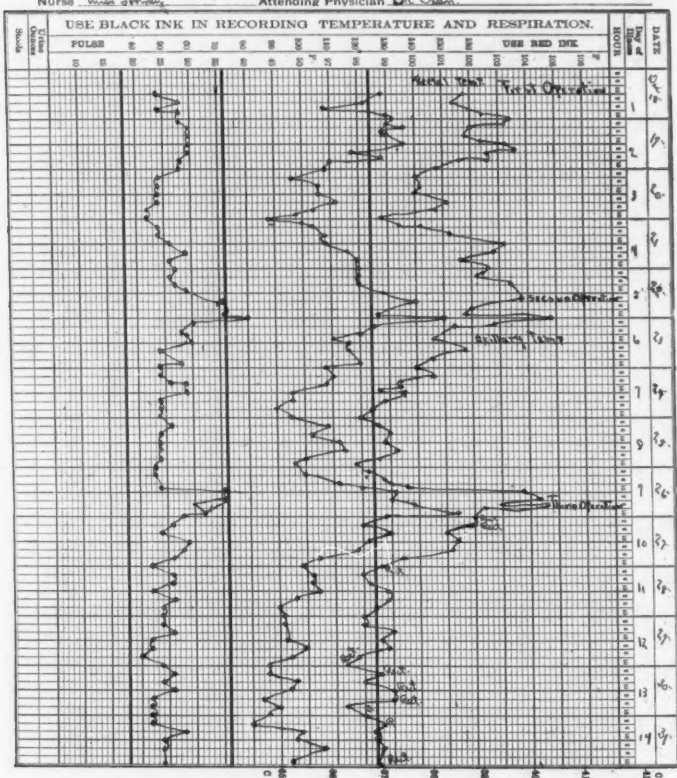
IOWA STATE UNIVERSITY HOSPITAL.

TEMPERATURE, PULSE, AND RESPIRATION CHART.

Name Frank B. Dean Age 5 Occupation _____

Disease _____

Nurse Wanda Armstrong Attending Physician Dr. Dean



ings around the individual muscles. To my great relief his temperature steadily decreased and on the second day was normal. From this time on the temperature did not go above 100°. The leukocyte count gradually increased and the differential polymor-

phonuclear count decreased. The patient was exceedingly weak for ten days. He was able to leave the hospital January 25, one month and seven days after the date of his admission. Throughout the course of the disease there was no evidence of systemic infection. The infection seemed always to be a local one. The question as to the lack of resistance shown by this patient being due to his whooping cough several months before was discussed. While every one seemed to think this a probable cause, no definite opinion was expressed.

This case was very unique in the experience of all concerned with it. I have been unable to find a similar case in literature. It is very regrettable that the material secured early for bacteriological examination was lost. There is attached a copy of the clinical chart for the first fourteen days in the hospital.

In the last two cases of severe sepsis, lack of resistance on the part of the organism seems to have been the prominent feature. Exposure to cold, hemorrhage and indiscretions on the part of the patient with the consequent diminution of resistance have been the most important factors in my cases of infection of mild degree also.

The virulence of the organism is also a feature perhaps almost as important. An exceedingly virulent organism introduced into the tonsil wounds would certainly with good resistance produce much trouble. The damage that a virulent organism can do even with no operative procedure has been nicely demonstrated in two families in my experience during the last year.

In the first family there were the two parents and three children living under poor hygienic surroundings. In two weeks each member had trouble. One child had measles. She developed a suppurative otitis media and meningitis. Subdural drainage was performed but the patient died. Two days later I operated upon a second child that did not have measles and found extensive acute mastoiditis and a large extradural abscess. Recovery at the end of two months. The mother developed an acute otitis with acute mastoiditis, the father a peritonsillar abscess and the third child a very severe double-sided cervical adenitis.

In the second family were two children, living in the best of hygienic surroundings. A month ago one child was brought to me after an attack of tonsillitis to see if the tonsils should be removed. There was a very severe double-sided cervical adenitis with some fever. Advice was given not to operate and ice packs prescribed.

The patient is now apparently well and will probably be operated in a month or so if in good condition.

A few days after I saw this child the second child developed tonsillitis, followed by meningitis and death.

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ABSCESS OF THE NASAL SEPTUM.*

BY GEORGE F. KEIPER, M. D., LAFAYETTE, IND.

Abscess of the nasal septum is a rather rare condition, and the recital of a case with the comments, that may accompany it, gleaned too from the experience of others, may better fit us for the treatment of this condition when met with. So far as the writer can ascertain, by reference to the Library of the Surgeon General's Office of the United States Army, and supplemented by articles since the publication of the catalogue of that office, but thirty-two articles have appeared upon the subject in hand. Of course this means more than that many cases, for some articles like Kicer's, deal with as many as a dozen. However, taking all together, the number after all is comparatively small.

Anatomy of the Septum: The septum is composed of cartilage, the quadrangular, and bone, the vomer and the perpendicular plate of the ethmoid. This is covered with mucous membrane, which for the cartilage is its perichondrium. We will need to keep this in mind as we proceed with the paper, especially as we consider the treatment of this condition.

Etiology: The most usual cause of abscess of the septum is traumatism, i. e., by blows upon the nose or falls thereon. The nose is so prominent an appendage upon the body that the wonder is that it does not suffer more serious damage than it does. The traumatism produces a hematoma, which evidently dissects up the mucous membrane upon both sides of the septum, in the majority of the cases, and forms the tumor. This blood soon degenerates and forms pus with great damage to the septum, from necrosis, because it is deprived of its blood supply. It may be stated that every case of hematoma of the septum does not go on to pus formation, for out of thirteen cases of hematoma reported by Kicer but five went on to suppuration. Diabetes, typhoid fever and erysipelas have also been noted as causes. G. Killian reports a case due to a dental cyst connected with the second upper left molar; Ballenger, a case due to the removal of a septal spur, and Parsons, a case evidently due to anthrax infection.

*Read before the Meeting of the American Laryngological, Rhinological and Otological Society, Middle Section, Detroit, Mich., February 22d, 1910.

Symptoms: The symptoms are those of severe inflammation. The temperature is usually but slightly elevated, though it may run as high as 103° , as in Cline's and Richard's cases. The swelling is marked, bilateral and occluding the nostrils. Breathing through the nose is out of the question. The upper lip is liable to be swollen. In a case of Gougenheim's, reported by Kicer, the swelling was unilateral, occupying but one nostril. The pain is quite severe, especially across the bridge of the nose and in the writer's case of a boring character and in the frontal bone. The nose is red from the inflammation and quite hot. The local temperature in the writer's case was one-half degree above the body temperature. Inspection of the nostrils reveals the bulging tumors in each side. They pit readily to the probe. If a hypodermic needle be inserted into the tumor, pus may be drawn therefrom, and if the case be seen early enough, blood.

Diagnosis: The disease is to be differentiated from syphilis of the septum, in which disease pus is liable to be present from the ulcerations that accompany the syphilitic process in but small quantity comparatively. Then, too, in the latter disease, if the center of suppuration *be on the septum*," according to Grünwald, "it is almost certain to be syphilitic." If the pus be present it is accompanied by a tumor in abscess of the septum and does not show until the mass is punctured. If syphilitic we will usually not have the nostrils occluded by the tumors formed in abscess of the septum by the confined pus therein. The history of injury will also aid in clearing the diagnosis, as syphilis of the nose does not show such injury as a rule. Finally Kalium Iodide may be tried as a last resort, and the microscope employed to find the spirochetæ of syphilis. Also the Wassermann Reaction.

Frequency as to Age: The cases reported have occurred at all ages. Very frequently it occurs in children. In four cases reported by Grünwald, three were children and one a young man.

Prognosis: The prognosis for preserving the integrity of the nose is good if seen early enough, i. e., before the pus has eroded the cartilage of the septum to any extent. For as long as a complete ring of cartilage is left, the saddle-back nose is not liable to take place. According to Kicer, Jurasez reported a case involving the septum by necrosis with collapse of the dorsum of the nose followed by healing of the perforation. In Casselberry's case the septum reproduced itself under the evacuated perichondrium. However, the septum is as a rule perforated before we see the

case and to make a prediction is hazardous until we have evacuated the abscess and determined the condition of the septum by the probe.

Complications: In Cline's and Culbert's cases, septicemia followed the injuries due to the pus being absorbed into the general system. Cline's case had been diagnosed as typhoid fever before he saw it. In Richards' case, it was several months before the patient was able to return to his work, so profoundly was he poisoned by the purulent process. In nearly every case systemic pus absorption is to be expected, with all the symptoms accompanying such absorption. In Culbert's case, a piece of the ethmoid was extruded. H. Hays reports septicemia following the submucous resection of the septum with one death. The worst complication from the standpoint of looks is sinking of the bridge of the nose, forming the saddle-back.

Treatment: According to Coakley, it may be resolved under two heads: First, evacuation of the abscess cavity; second, prevention of deformity. As noted above, the septal cartilage receives its nutrition from its overlying mucous membrane, which in this disease is dissected up from the cartilage and the latter thus deprived of its nutrition. Hence the earlier the abscess is opened the better. In fact, if patient would come before the hematoma becomes an abscess, it would be all the better, for it does not take long for a septal cartilage to melt away into pus. Hence a free incision is necessary, and in the writer's case one was made in each nostril to secure prompt and efficient drainage. Coakley suggests after making the incision, to pass a probe into the back of the nostril and draw it forward, making pressure against the septum, thus stripping the abscess cavity of pus. He then inserts a Simpson tampon into the nostril, so that its anterior end rests just posteriorly to the incision. Wetting the tampon will cause it to swell and thus to press more firmly against the septum. In a few days the tampon is removed and replaced with hollow splints inserted in their stead.

It is regarded as bad practice to curette the abscess cavity, as thereby more damage may be done the cartilage of the septum than what has been done by the abscess, and thus saddle-back nose be produced. In the writer's case simple drainage with gauze was all that was required.

Writer's Case: Mrs. Clarence N., aged 28, consulted the writer August 11, 1909, with both nostrils occluded and suffering from much pain inside the nose and across its bridge, and in addition

horing pains running towards the forehead. A week before she had been struck across the nose by a thug and rendered unconscious. Inspection of the interior of the nose showed a bulging bilaterally into each nostril, and nearly occluding them. Each tumor pitted to the probe. The temperature under the tongue was 101° and in the nose, one-half degree higher. Feeling that pus was present, incision was advised. It was accordingly made in each nostril and a large quantity of pus was evacuated from both sides of the septum. The probe showed a hole in the septum. Small gauze drains were inserted in both incisions and left in for a couple of days and then removed. The mucous membrane resuming its normal position, no tampons were inserted. In two weeks the nose was perfectly normal in appearance. The outcome was very happy considering the amount of pus evacuated.

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Syphilitic Mastoiditis. F. ARDENNE, *Rev. Hebd. de Laryngol. d' Otol. et de Rhinol.*, March 12, 1910.

The localization of tertiary syphilis in the mastoid apophysis presents certain difficulties in the diagnosis, at least in the early stages as in the case reported by Ardenne. The patient, a woman of 48, had suffered from swelling and pain over the mastoid process and had called at the clinic where a diagnosis of primary mastoiditis had been made. The patient had refused operation and continued local application, and eventually suppuration took place through a fistulous opening. When the patient applied to the author, he was struck by the peculiar development of the case and the absence of any inflammation in the middle-ear. In spite of the negative history he prescribed the mixed treatment which resulted in an improvement in 10 days and entire recovery in 3 weeks.

He quotes Schwartze, who states that syphiloma or gumma may develop in the form of a mastoid periostitis, may give a sensation of fluctuation and take on an acute process, but disappears rapidly under the influence of specific treatment.

SCHEPPEGRELL.

A FORCEPS FOR THE CONTROL OF TONSILLAR HEMORRHAGE.*

BY SYLVAN ROSENHEIM, M. D., BALTIMORE.

The two dangers of the modern method of removal of the faucial tonsils by dissection are the anesthetic and hemorrhage. The former can be guarded against by the employment of ether in the hands of an experienced anesthetist. He should keep the patient just enough asleep to allow the operator to work. After such an anesthesia, the patient awakens in a very short time after completion of the operation.

The forceps, illustrated here, are modeled closely after those of Jackson, the bite, however, being stronger. An attachment like that on the Shoemaker forceps, facilitates tying after the bleeding point is caught.

The tonsils are dissected out with capsule intact, after the method of Worthington, using seizing forceps and Seiler's septal knife, strengthened for this particular purpose. After removal of the tonsil, one or more sponges, held on Kelly clamps, are placed in the fossa and held there for a while. The fossa is then inspected for bleeding points as described by Cohen. Sometimes a spurting artery is seen on the anterior surface of the posterior pillar or the posterior surface of the anterior pillar. The hemorrhage frequently comes from a large vein running from above down, in the center of the tonsillar fossa. This vein is responsible for the severe hemorrhage which often occurs just as the tonsil is removed, and is soon controlled by pressure. In a recent case this vein was torn away in the lower portion of the fossa and flopped around in the fossa, causing considerable bleeding until clamped and tied. A comparatively large artery is frequently severed about the center of the fossa and the blood spurts almost out of the mouth.

The bleeding vessel or point is grasped with the forceps, while an assistant depresses the tongue and retracts the anterior pillar. The assistant then holds the forceps, while the operator introduces one finger to the end of the forceps, holding one end of the ligature there and drawing on the other one with the other hand, which need not be introduced into the mouth. As the ligature is tightened, the assistant elevates the forceps slightly from the floor of the fossa. This is readily done as the tissue is very loosely attached there.

*Presented to the American Laryngological, Rhinological and Otolological Society, Washington, D. C., April, 1910.

Sometimes but one bleeding point on each side is tied and sometimes none. It is rarely necessary to make more than three ties in the case of severe bleeding, and this is usually the case when a

The most difficult places to tie are at the base of the tonsil and small amount of muscle is accidentally removed. high in the supratonsillar fossa. The act is facilitated in the latter location by inverting the fossa and by grasping the soft palate with a long dressing forceps.

Since using this method of controlling hemorrhage, in a period of over half a year, the writer has had but one case of secondary hemorrhage. In this instance the operation was performed under cocain-adrenalin anesthesia and the use of the adrenalin so con-



tracted the vessels that the latter did not bleed at all at the time of the operation. Professional friends have told me that most of the cases in which they have had secondary hemorrhage have been in cocain cases. For this reason, as well as on account of the disagreeable effects frequently caused by cocain, ether narcosis is to be recommended.

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1710 Linden Avenue.

**A REVOLVING CHAIR, RESTING ON BALL-BEARINGS, FOR
THE MAKING OF "TURNING" TESTS.**

BY SAMUEL IGLAUER, M. D., CINCINNATI.

The chair shown in the illustration was devised for making the "turning" movements in the testing of the vestibular apparatus. In order to facilitate the turning, the seat rests upon the ball-bearings shown in Figure B, and it therefore requires but very little effort to



cause the chair to revolve. The base is made of iron to insure stability and is of sufficient height to prevent the patient's feet from touching the floor. I am indebted to Max Woche & Sons Co., of Cincinnati, for the care they have shown in the construction of this chair for me.

22 West Seventh Street.

SOCIETY PROCEEDINGS.

NEW YORK ACADEMY OF MEDICINE.

SECTION ON LARYNGOLOGY AND RHINOLOGY.

Regular Meeting, January 10, 1910.

(Proceedings continued from page 674.)

JOSEPH H. ABRAHAM, CHAIRMAN.

DISCUSSION.

DR. WATERMAN reported a case of tonsillar hemorrhage which occurred in his service at St. Mary's Hospital several years ago—a young German woman, 20 years old, upon whom he performed a tonsillotomy. Although the surface of the tonsil was soft, there was so much cicatricial tissue in the tonsil that one could hear the knife cut through the tissue. There was a free hemorrhage at the time of the operation. He saw her again the second day after the operation, when she reported that upon her arrival at her home there was an alarming hemorrhage, which was controlled by a physician who was making a call in the house. Twelve days later he was called to see the patient, who had again had a severe hemorrhage from the tonsil. The patient complained that the room seemed to be going around, and that she could not see. Examination showed that a small artery situated deeply in a cicatricial sulcus in the left tonsil was bleeding in spurts across the pharynx with each heart beat. A pudget of cotton on a cotton carrier was dipped into boiling water and pressed against the bleeding point. The hemorrhage ceased immediately and there was no recurrence.

DR. LEDERMAN said that Dr. Bodine's remarks were of practical value. He recalled a case of hemorrhage following amputation of a portion of the uvula, which had very little bleeding at the time of operation. The patient left the office and kept on sucking his uvula, and was back again in a half hour with a slight dripping from the wound; it could scarcely be called a hemorrhage, just an oozing, which subsided under an astringent. Two hours later the patient's family physician was called to the patient's home and found the same condition. He touched it up with Monsel's solution and told the patient to remain quiet. The man returned again to my office about nine o'clock that evening, and had a mass of clotted blood from the Monsel's solution, which required half an hour to

remove. The bleeding was again checked with astringents. By this time the patient was quite nervous and after leaving the office he continued sucking the wound and returned in $1\frac{1}{2}$ hours with a slow oozing; he said he was anxious to see if it kept on bleeding. A ligature was then applied around the stump of the uvula. After the use of instruments other than cutting ones the speaker has had a serious hemorrhage after the use of the galvano-cautery snare. In one case the hemorrhage occurred 5 days after a galvano-cautery snare operation for the removal of very large tonsils in a medical student. The patient took some toasted bread and that removed the eschar. A severe hemorrhage followed which was controlled by a neighboring physician, who used some astringent. When Dr. Lederman arrived there was a clot on the wound extending into the lower pharynx and slight oozing. He simply employed a saturated alum solution without removing the clot and the bleeding ceased.

In another case in a boy 12 years of age, with no obtainable history of excessive bleeding, both tonsils were removed under anesthesia. The character of the oozing which followed led him to desist removing the adenoids. The bleeding was checked at the time of operation by pressure, but the next morning the patient was so exsanguinated that he was given a rectal irrigation of $\frac{1}{2}$ pint of claret in a quart of hot water; his pulse was 130, temperature 103° . He reported that he had vomited a large quantity of blood which he had swallowed. Upon further questioning his mother, it was found that some years previously he had a very severe attack of bleeding after having a tooth pulled, which continued for a week. It was 2 weeks before he left his bed. Many of these patients start the hemorrhage by sucking at the wound, and thus removing the clot which has formed.

There is no doubt in the speaker's opinion as to the existence of the hemorrhagic diathesis.

DR. COFFIN said that he could not discuss the papers except in a general way as they applied to tonsillar hemorrhage. He had had no experience of status lymphaticus and knew little of hemophilia. He recalled one case of hemorrhage, however, following a slight operation on the nose. The young man bled to fainting. After he had recovered he had a tooth pulled, and the same thing occurred again. He did not think he could be easily persuaded upon to operate on the case again. A case in which the tonsils were removed by a physician who had no hospital facilities was sent on account of hemorrhage to the Manhattan Eye, Ear and Throat

Hospital, and assigned to Dr. Coffin's service. The bleeding continued for several days, in spite of efforts to stop it with clamps. The members of the house staff were kept up nights applying astringents, etc. Dr. Coffin sewed together the anterior and posterior pillars, passing the sutures through the stump of the tonsil. The bleeding stopped for two days, then began again and continued until the external carotid was tied, after which the patient made a rapid recovery. Two weeks ago he had operated on a strapping big fellow, 22 years of age, removing the tonsils with a snare. There was no bleeding at the time, but in the morning the doctor was informed by the house surgeon that a moderate hemorrhage had occurred in the night, which had been easily controlled by clamps. After 48 hours the patient was allowed to go home. He reported at the doctor's office the next day, and in the night following Dr. Coffin was called to his home to find him holding a tumbler nearly filled with blood. A cork was put between the patient's teeth and he was told to keep it there while the doctor was getting ready other means of checking the bleeding. It had little effect, however. The bleeding was finally controlled by the application of a 480 grain solution of nitrate of silver to the point of bleeding. Four days later the doctor was called at 2 a. m. and informed that the patient was bleeding again. It took some time probably 45 minutes, for him to reach the patient, whom he found holding a cork between his teeth. He had so held it some time before the doctor had been called, but was still bleeding. After this experience Dr. Coffin confesses to having lost confidence in the entire and absolute efficacy of the cork, although probably it is a good thing to try. He again applied nitrate of silver, but the bleeding was not so easily controlled as before, and he finally decided to take the boy to the hospital where he could be better watched. A slight hemorrhage occurred on the following day, again controlled by nitrate of silver, which was afterward applied daily in a 60 grain to the ounce solution for about 5 days, when the young man was discharged, out of danger from further hemorrhage.

DR. EMIL MAYER recalled the case of a young boy who had very large tonsils, the parents saying they feared any operation in their family as they were bleeders. No operation was done, but the galvano-cautery applications made.

Some two years later the mother of this boy had an operation done for hemorrhoids, telling the surgeon of the bleeding family tendency. The operation was done, no special bleeding occurred until the tenth day, when an enormous bleeding occurred, which

was difficult to control. The surgeon, the speaker believes, is now convinced of the existence of hemophilia.

The speaker recalled the case of a young man who had a tonsil removed at the New York Eye and Ear Infirmary some years ago and that the late Dr. Asch, Dr. Charles H. Knight and himself took turns in digital compression for many long hours, finally controlling it. It was subsequently learned that he had an almost uncontrollable hemorrhage after a tooth extraction a year previous, and some two years later he had a small aural polyp taken off with long-lasting hemorrhage. These two instances are surely those of hemophiliacs.

Our great interest in the question of bleeding has made us rather slight the very valuable paper of Dr. Packard, which is so instructive. And the point that we should record our unfortunate results is very well taken. If more of this were done we would be more charitably inclined when the unforeseen, unexpected and most unhappy catastrophies arise in our associates' practice.

DR. KENEFICK said that some twelve or thirteen years ago he had a fatal case of hemorrhage following a simple adenoid operation. The patient, a boy, was operated on Tuesday and kept alive until Friday. It was an ordinary slow oozing case, such as had been described to-night. After the death of the child he made a point of visiting the parents at their home to determine if there was a distinct history of hemophilia in the family, and found that a child two or three years previously had bled to death immediately after birth; that a younger brother was afflicted with swollen joints, a condition described in the text-books under hemophilia. Neighbors of the family informed him that they had noticed certain peculiarities in these children, for instance, when they were bumped or bruised large swollen discolored spots would appear, and other undoubted peculiarities of circulation regarded in the text-books as occurring in hemophilia were noted. The doctor said that he was very grateful for the description given in the text-books on internal medicine, for it saved him from a suit for damages, as he was able to demonstrate that the conditions which existed in the family corresponded to the conditions described in the text-books. He had also prevented an operation for resection of the knee-joint in the deceased boy's brother by a prominent orthopedist by reporting to him the results of his investigations in the family. In a large general hospital a similar case that had been operated on at that time by a prominent orthopedist for resection of the elbow, had bled to death from the wound in spite of all efforts to stop

the hemorrhage. Dr. Kenefick said that he believes there is such a condition as hemophilia, and it should not be eliminated for obvious reasons from fatal cases of hemorrhage following operations.

DR. DELAVAN said that in reading articles upon the subject of the tonsils written a number of years ago, it would be found that much was then known about their treatment which had not since been improved upon. On the other hand the last twenty years had shown great advances in certain directions in our knowledge concerning them. The two admirable papers of the evening had presented in excellent form the best of the recent information pertaining to the subject, and the speaker was particularly indebted to both Dr. Packard and Dr. Newcomb for having brought forward the newer ideas in so clear and forcible a manner. In the space of a five-minute discussion it was impossible to touch upon all the points of interest which had been gone over in the papers. The speaker would confine himself to but one or two.

He heartily agreed with Dr. Newcomb in the necessity of recognizing the different varieties of enlargement of the tonsil which might be present and of selecting the method of operation where the tonsils required removal with reference to the particular type to be dealt with. Thus not all hypertrophied tonsils were of the practically pedunculated type and not all were of the type which called for the process of enucleation, now so popular with some operators. He believed that the so-called enucleation of the tonsil should be practiced with discretion. The method was very old; it had been revived and practiced in France in the seventies, but for some reason, had not come into general popularity. It would be desirable to ascertain its final effect upon the pharynx before unhesitatingly adopting it as a standard method. Without question, however, there were some cases in which it was useful.

The subject of hemorrhage after tonsillotomy the speaker believed was often misinterpreted. The degrees of bleeding referred to in the paper of Dr. Newcomb well represented the state of the case. It was hardly fair to call a smart bleeding which lasted but a few moments after the removal of the tonsil a hemorrhage. An actual case of hemorrhage after tonsillotomy was a very serious accident and one which, once experienced, could never be forgotten. All cases of severe hemorrhage from the tonsil are not necessarily of the same origin. Their varieties might be illustrated briefly by the following cases:

A light complexioned girl, 8 years of age, had undergone a double tonsillotomy. Profuse capillary oozing of red blood fol-

lowed and continued until the child was much weakened. It was finally checked, but returned on the first occasion when food was swallowed. The second time it was stopped with difficulty, and the third time it occurred again after swallowing, seriously threatening the life of the patient. The observance of quietude, and feeding by the rectum, prevented return of the hemorrhage. This case illustrates the capillary bleeding sometimes seen. The speaker was unable to obtain a history of hemophilia in the family, although it may have existed.

In another case seen by the speaker bleeding of a totally different character followed the removal of an enormously large tonsil in a middle-aged man. The operation was performed with a Matthieu tonsillotome. The blade of the instrument passed completely outside of the tonsil, through the connective tissue upon which it rested, excepting at its lower and outer aspect, where the venus plexus belonging to this location was encountered. The removal of the tonsil was followed by an instantaneous rush of dark-colored blood, evidently of venous origin. Hemorrhage was violent for a few moments, but was readily checked by pressing a piece of ice into the bleeding cavity. There was no recurrence.

A third and far more serious case was that of a man of 28 years of age, from whom a fragment of tonsil about as large as the end of one's thumb was removed from the superior part of the right tonsillar fossa by means of the Mackenzie tonsillotome. There was slight bleeding at the time, but the patient disregarded all instructions. Shortly after leaving the house he ran to catch a car, at the same time vigorously clearing his throat. The result was slight bleeding, which became more and more annoying until he returned to my office. The bleeding increased in volume in spite of every effort to check it—cold, hemostatics, pressure, both local and to the carotids, the cautery, the cutting off of the circulation of the limbs and the various other methods recommended at that time were all applied without avail, the hemorrhage becoming more and more profuse. Everything had been done to reassure the patient and to quiet his alarm, but his heart-action and the bleeding became more and more violent. Despairing of stopping it otherwise I administered a hypodermic of morphine and took the man to the New York Hospital for the purpose of securing a ligation of the carotid artery. On reaching the hospital he fainted; the bleeding immediately stopped and it never recurred. This was the worst case of tonsillar bleeding that I have ever seen. The patient was a remarkably large, robust and full-blooded man. He

was almost exsanguinated and did not recover from the resulting anemia for many weeks. When I remember the situation when the bleeding was at its height and think how impossible it would have been to apply some of the methods recommended for tonsillar bleeding, I am led to question whether the authors of them have ever had such an experience as mine.

A microscopical section of this tonsil showed four blood-vessels, of such small size that it seemed impossible that such profuse loss of blood could have emanated from them. These vessels had been recognized during the progress of the bleeding and, as mentioned above, efforts had been made to seal them both by torsion and by the application to their mouths of the solid stick of nitrate of silver, a method which I had often found successful in other cases. The blood lost was of a bright red color, denoting it to be arterial. It is interesting to note that this occurrence so impressed him that he gave up his career as a clergyman and studied medicine. This case illustrates hemorrhage from small arterial branches. Happily, I have never seen a case of the fourth type, but the records show that in rare instances where a tonsil has been removed, there has been an instantaneous gush of arterial blood, which has cost the patient his life within a few minutes, and this evidently from the severing of a large arterial branch.

The treatment applicable to these four types of cases obviously could not be the same in all. Attempts at operation during a really dangerous hemorrhage are attended with extreme difficulty. The speaker believed that a method known as the purse-string ligature and others of its kind could hardly be available in the worst cases. In the experience of the writer the administration of opium to quiet the excitement of the patient and the introduction of syncope, had brought relief when other standard means had failed.

With regard to the surgical aspect of these cases the proposition that the carotid should be tied was one of very doubtful value. In the first place these cases were apt to occur under conditions where the tying of the carotid might not be easily managed and where the securing of the surgeon might mean the loss of valuable time. To be really effective, our resources should be readily attainable and of easy and prompt application. Where the hemorrhage is less sudden and violent, the propriety of ligation of the carotid might be taken into consideration. Meanwhile, the anatomical considerations of the subject are important. The actual sources from which tonsillar hemorrhage may arise are somewhat obscure, since the blood supply of the gland is derived from a consider-

able number of different arterial branches which, together ramifying through it, render it difficult in the living subject to trace the connection of any one twig with its parent branch. Moreover, anomalies are common and while the ascending pharyngeal is probably in most cases the largest contributor it is sometimes small and precedence is then taken by the ascending palatine. Bleeding must in the great majority of instances be from some of these smaller arteries. It must be rare indeed that the internal carotid itself has been wounded by the use of the tonsillotome. Formerly the generally conceded views were in favor of ligation of the internal carotid in case of serious hemorrhage. Of recent years various authorities have expressed a preference for ligating the common carotid. In a few cases reported this has been successful. In others it has totally failed, while efforts at holding the artery have seemed equally ineffective. The objection that ligation of the common carotid may unduly cut off the supply of blood to the brain is hardly to be considered under the exigencies of a dangerous tonsillar hemorrhage. The wounding of the internal carotid itself, an accident most unlikely to happen, would be likely to cause death before efficient aid could be given. The cases of severe bleeding which have been reported have been plainly referable to the division of the smaller class of vessels. Not even these vessels can come from the internal carotid unless they are branches of the ascending pharyngeal when that vessel, as sometimes happens, is given off anomalously from the internal and not from the external carotid. According to Gray, the cervical portion of the internal carotid gives off no branches. No branches from it therefore can be distributed to the tonsil. Normally, the branches which do supply the tonsil are derived primarily from the external carotid, and although some of them naturally anastomose with their fellows of the opposite side, they practically depend entirely upon the carotid. To ligate the internal carotid therefore would be uncalled for. To ligate the common carotid would certainly shut off the circulation in that artery and its branches, including the external carotid from below. Ligation of the common carotid cannot cut off communication between the external carotid and the internal. Moreover, with its circulation stopped from below, a very considerable supply of blood may be received from the arteries at the base of the brain, carried down to the bifurcation of the common carotid, and thence into the external carotid and its branches. This may explain why the results of tying the common carotid have not been more successful. In order to operate with a

maximum certainty of success and with the least possible surgical interference, the external carotid should be ligated and the ligation should be made behind the ascending pharyngeal and between it and the bifurcation of the common carotid. In view of the accidents which have happened in removing the tonsils it goes without saying that reasonable precaution should be taken to insure the safety of the patient and to provide help in case of need. It is significant that serious hemorrhages have rarely occurred in patients under 18 years of age.

With regard to the existence of the condition known as hemophilia, experience and observation would seem to have made it plain that it is a genuine thing which, when present, cannot be lightly regarded. In the volume of the Transactions of the American Laryngological Association for 1909, Dr. Thomas Hubbard of Toledo, Ohio, furnishes an admirable article entitled "Hemophilia, with Remarks on the Hemorrhagic Diathesis." It is well worthy of study. Anyone who has seen a case in which bleeding has been due to this diathesis will readily distinguish between it and bleeding of the ordinary kind caused by the separation of a few blood-vessels. And when the patient has died from some simple wound, in spite of every effort to check the bleeding, the doubter will be willing to admit that the hemorrhagic diathesis exists and that where present in marked degree it is a very serious thing. I have seen several such cases and am so thoroughly convinced of the possibilities of the existence of hemophilia that I always investigate its possible presence before undertaking an operation.

DR. MYLES said that there were one or two points concerning which he would like to speak. We are indebted to the laboratory men for some very important knowledge concerning the coagulation of the blood. He would suggest that a series of cases be given chloride of calcium for a week or two, and notes be made at intervals on the coagulability of the blood. Scientific data that would be of value could be obtained by this process.

In regard to hemorrhage after the modern method of enucleating the tonsils, he would like to refer to a little instrument which he has been using for several years successfully. It is a species of angiotome, made after the models of artery forceps, but much heavier and longer. The straight ones are preferred, for one can engage the bleeding vessel or area better than with the curved one. He had had three cases of hemorrhage within the last month, and

found the use of the angiotome which he presented sufficient to correct each one.

DR. WILSON said that Dr. Myles had spoken of the point he himself wished to emphasize, that is the surgical procedure in stopping the hemorrhage. We should do as the general surgeon does, catch the artery and either squeeze or ligate it. It is not easy to ligate an artery in that condition. The most satisfactory means that he has found for this purpose is the instrument which Dr. Yankauer devised for suturing in the nose. It is a very valuable instrument in these cases.

A New Tonsil Tenaculum. Presented by W. W. CARTER, M. D.

The instrument consists of two curved prongs, each making a half-turn of a screw. These are mounted on a long shaft. It is simple; its traction-area is the greatest possible within the limited area; the twisting action of the instrument tends to center the ton-



sillar tissue; sponging of the throat can be done without getting gauze caught on instrument, since the points are embedded. The instrument is of great use in removing soft, mushy tonsils, and in submerged cases.

Two Laryngeal Forceps. Presented by R. C. MYLES, M. D.

Many years ago this instrument was presented before the American Laryngological, Rhinological and Otolological Society, and published in their transactions. It is the author's modification of the Dundas Grant Forceps. The cutting blades are made to revolve in all directions, and it has a very delicate mechanism. It was constructed for the special purpose of removal of subglottic growths. He had never seen any instrument that could compare favorably with it in efficiency. The second set of laryngeal forceps he had lately secured from Hardy & Co., which they stated was a modification of Tobold's forceps. The handle and cannula of this set possessed many superior qualities, and if combined with his modification of Dundas Grant's blades would make up a set, than which he had not seen one more serviceable.

**A UNIFORM ACOUMETRIC FORMULA ADOPTED BY THE
EIGHTH INTERNATIONAL OTOLOGICAL CONGRESS
AT BUDAPEST, 1909.**

REPORT OF COMMITTEE ON ACOUMETRY.

DR. JÖRGEN MÖLLER, SECRETARY.

This uniform formula supplies a need felt for many years. It is of the following nature:

The abbreviations of each test are the initial letters of the corresponding Latin name; the pitch, however, is always given according to the German musical method. For instance, the

\rightarrow AD	25	20	30	$\div 8$	2,0	8,0	15,0
W S (15) + 5	a^1 M (20)	a^1 A (60)	c^4 A (30)	R (35)	H (3,0)	P (15,0)	V (38)
AS	20	60	30	+ 35	3,0	15,0	≥ 20
		3,0	D ¹	40.000			
		v (78)	Ll	LS			
		15,0	C ₂	40.000			

AD=auris dextra; AS=auris sinistra; W=Weber's test. Lateralization is designated by an arrow pointing in the respective direction; no lateralization by an = sign placed after the W; if the fork be not heard at all by bone-conduction a O is placed. S=Schwabach's test. Variation from normal perception time is indicated by + or \div the number of seconds. An = sign means normal perception time. Tuning-fork a^1 (435) is used and its normal perception time (a^1 M) upon the mastoid process (M) must be added in parenthesis. Perception time for right and left ears above and below is indicated in seconds. In a superficial examination + or \div may be used to indicate a lengthening, \div a shortening, and = normal perception time. Where only difference in time is measured, normal perception of time of fork must also be added. Instead of a^1 , another fork, viz., c^2 may be used.

a^1 A=perception-time of fork a^1 (435) placed directly in front of meatus (A=air, air-conduction). Other symbols same as in bone-conduction. c^4 A=time-perception of tuning-fork c^4 (2048) held directly in front of meatus. R=Rinné test; if air-conduction be greater a + sign is used; if bone-conduction be greater, a \div sign; if equal, an = sign. In superficial examinations + or \div may be used without adding the number of seconds; +t=fork

heard only by air-conduction, $+d$ =fork heard only by bone-conduction, t (air-conduction) $\div d$ (bone conduction). If the Rinné test time of variation be estimated, the normal variation must be added in parenthesis. Tuning fork a^1 (435) is used.

H =horologium (watch). Normal distance of hearing in meters is added in parenthesis. AC =ad concham (watch heard in contact with auricle). P =Poltzer's acoumeter. Hearing range designated as in watch test. V =vox (ordinary conversational voice, v =whisper. Hearing range written in meters, test work added parenthetically; $a>$ prefix to number of meters shows that all test words were heard at the greatest available distance and some may be audible at greater range. O, O_1 (i. e., 1 cm.)=voice heard only close to ear. If the test be made with equintensor and isozonor words, the values for different groups are joined, the deepest being placed first.

LI =limes inferior (lower border), determined if possible by the Bezold's tone-series. If only c fork-series are at examiner's disposal $<$ suffixed to record of lowest fork shows that deeper tones may be heard. Series used must be designated. LS =limes superior, determined through Edelmann-Galton whistle.

Pitch of fork and other sound-sources are designated as follows: Scale= c, d, e, f, a, b . An addition of s or es =half tone lower. Octavos $C_2, C_1, C, c, c^1, c^2, c^3, c^4$; $c=16, 32, 64, 128$, etc. double-vibrations.

THE OTO-LARYNGOLOGICAL LIBRARY OF THE COMMUNAL HOSPITAL IN COPENHAGEN.

The Oto-Laryngological Library attached to the Ear-and Throat-Clinic of the Communal Hospital in Copenhagen, has succeeded in obtaining a collection of about 3,000 articles and reprints, besides about 200 volumes of standard books, monographies, etc., etc., on oto-laryngology, mostly gathered through the kindness of many confrères abroad. Dr. Mygind thanks his confrères very heartily for their many gifts to the said library, and at the same time begs authors of oto-laryngology works, in the future, to send their reprints, books, etc., to the library. The library has a number of double reprints which are at the disposal of other similar institutions.

